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HOW THISTLES SPIN.

BY PROF. W. J. BEAL.

A HASTY glance at a plant of *Cirsium altissimum*, a very tall thistle, shows that the main stem, its branches, the midrib and prominent veins of the leaf are clothed with soft slender hairs. The entire under surface of the leaf is white or gray with a dense coat of cotton. The scales of the spiny-tipped involucre appear as if they were tied together by numerous gossamer threads. If the young leaves and buds are pulled apart many fine threads spin out an inch or more until the parts are separated far enough to break the threads.

Under a magnifying power of one hundred diameters, the larger hairs, an eighth of an inch in length, are seen to be composed of a row of about fifteen cells placed end to end. The largest hairs are found on the stems and midribs.

At the top of the jointed hairs is a long lash, sometimes an inch in length which generally extends towards the tip of the leaf or stem. These hairs are very numerous, and stick more or less to each other. Fig. 1 is a good representation of one of these hairs while young, before it has been drawn out at the extremity. Fig. 2 represents a similar hair more highly magnified. In the latter case some of the cells have been used up to form the thread-like lash at the extremity.

FIG. 1

Young hair on stem of *Cirsium altissimum*.

FIG. 2

Older hair with part of thread.

In Fig. 1 the hair appears not to have acquired its growth. Near the base the cells are still very short, and not as they appear at the base of figure two. Some of the upper cells are slightly darker, and are filled with a yellowish-white mucilage. When young, the extreme cells are long, smooth and tapering. At that time they lie flat on each other, and are sticky and adhere to the tips of the hairs which they overlap. As the leaf or stem grows in length, the hair-stalks straighten up, and from the tip of each a thread is drawn out. In this process some of the cells are exhausted and used up in the thread.

When the flower-bud is an eighth of an inch in diameter and one of the surrounding scales the twentieth of an inch in width, some of the hairs on the margin of the scale appear like Fig. 3, where one short cell is tipped with another—long and slender. These tips are sticky and may be easily drawn out. As the buds expand, the tips of these hairs are caught and drawn to the right or left by the scales next to them. When full grown the heads look as though a spider had spun webs round and round the outside. At this time the hairs appear like Figs. 4 and 5, where there is a long lash with one or two or rarely more cells at the base. Fig. 6 shows the edge of a scale of the involucre with one of

FIG. 3

Margin of young scale of involucre.

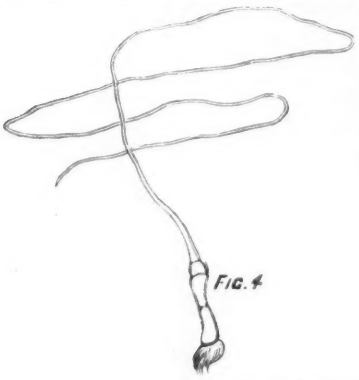

FIG. 4

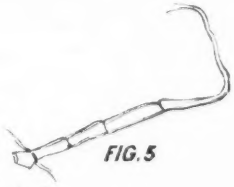

FIG. 5

Hairs on the back of a full-grown leaf.

these hairs, the part of another, and a couple of short prickles.

The webby layer of white or gray on the under side of the leaf is composed of cells similar to those last mentioned. They appear to grow in a similar manner. As the young leaf spreads and elongates, each hair draws out a thread which helps to cover the under surface with a dense web. This web adheres quite closely and firmly to the surface of the leaf.

The leaves of several other plants, like the Concord grape, Centaurias, etc., are covered in a manner similar to the leaf of the thistle. The branching hairs of the mullein and leaves of button-wood, when very young, are like those of the thistle, only the extremities are not sticky.

In the New Testament we read, "Consider the lilies of the field, how they grow: they toil not, neither do they spin." This was not said of thistles nor of grape vines.

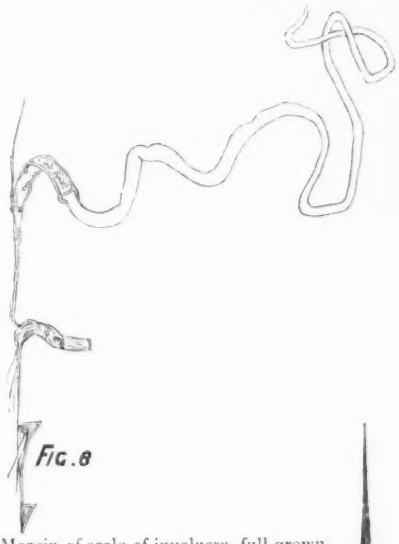

FIG. 8

Margin of scale of involucre, full grown.

The thread of the thistle is single and slowly drawn out. Perhaps it may be called a clumsy affair when compared to the delicate cable of the spider, with its numerous strands. The thread of the thistle answers well enough the purposes for which it is intended. It protects the plant from sudden changes of weather, keeps the rain from wetting the surface, and probably to some extent keeps enemies from injuring the plant.

FIG. 7

Scale of *C. altissimum*, showing gland at *a*.

There is one other fact of interest about the thistle under consideration. When full-grown the scales about the heads of flowers have each an oblong gland just at the apex where the spine starts up. Fig. 7 shows this gland. The object of the gland I am as yet unable to determine. It may and probably does attract insects. It often entraps them. I have many times seen six to ten small flies and *Hymenoptera*, some of them half an inch in length, held fast by mouth or legs or wings. Here they buzz and twist and pull till strength and life are exhausted. Whether this is of any use to the plant for food or amusement, to keep away larger insects, or to attract spiders or ants, I have not yet ascertained.

PLANTS USED BY THE INDIANS OF THE UNITED STATES.

BY DR. EDWARD PALMER.

[*Concluded.*]

Textile Plants.—Yucca baccata. This is one of the most useful plants to the Indians of New Mexico, Arizona, and Southern California. Its fruit is eaten while fresh and in the dry state. It grows from two to eighteen feet in height, and becomes a tall tree further southward, varying in diameter from eight to twenty inches. The bodies of these plants are very fibrous. The Indians and Mexicans when in want of soap cut the stems into slices, beat them into a pulp, and mix them with the water in washing as a substitute for soap, for which it answers finely. The leaves are generally about two feet in length and are very fibrous. In order to remove the bast the leaves are first soaked in water, then pounded with a wooden mallet, at the same time occasionally plunged into water to remove the liberated epidermis. Then if not sufficiently clean and white it is returned to the water for a time and again put through the beating process; generally the second course is sufficient. The fibres of the leaves being strong, long and durable are adapted for Indian manufactures, and the savages of Southern California make therefrom excellent horse blankets.

All the tribes living in the country where this plant is found, use it to make ropes, twine, nets, hats, hair brushes, shoes, and mattresses.

The Diegeno Indians of Southern California have brought the uses of this plant to notice by the various articles they make from its fibres, and sell to white settlers. In preparing a warp for the manufacture of saddle blankets, it is first loosely twisted, then when wanted it receives a firmer twist. If the blanket is to be ornamented, a part of the warp during the first process, is dyed a claret brown, oak bark being used for that purpose. The loom in use among the Indians of to-day is original with themselves, and not borrowed, as some suppose, from the Spaniards. It is a simple affair consisting of two round, strong, short poles, one suspended and the other fastened to the ground. Upon these is arranged the warp. Two long wooden needles with eyes are threaded with the filling which is more loosely twisted than the warp, in order to give substance or body to the blanket. Each time that the filling is thrust between the threads of the warp by

one hand, the Indian female with a long, wide, wooden implement in the other hand, beats it into place. This tool resembles a carving-knife, but is much larger and longer. One edge is thin, and in this is made a number of teeth or notches not so sharp as to cut.

This plant so fibrous, and so abundant on land utterly worthless for the growth of anything more valuable, can be had for the gathering; and as paper materials are scarce, either alone or mixed with straw, would be valuable in the manufacture of that article.

Y. brevifolia.—The leaves of this plant are short, and not useful for Indian purposes, but it produces abundance of large seeds which contain much nutrition; they are ground fine, and either eaten raw or cooked in the form of mush by Southern California Indians. Vast tracts are covered with it, which assume a forest-like appearance about the Mojave river, Southern California, having trunks from ten inches to two feet in diameter, and twenty-five feet high, with numerous branches. Not only is the leaf fibrous, but the body is more so. As raw material for paper it is excellent.

Y. whipplei.—This plant in bloom is one of the finest garden ornaments, very common over most parts of California. The young flowering stems while in their tender condition, are eaten either raw or roasted by the Indians. The seeds are gathered, ground into flour, and eaten. The leaves yield a very soft white fibre which is capable of being made into very nice thread. Indians use this fibre to form a padding to their horse blankets, the outer part of which being made of the fibre from the *Yucca baccata* is very rough. A wooden needle is threaded with twine made from the same fibre, and the lining is firmly quilted to the saddle blanket forming a soft covering without which it would injure the animal's back.

Y. angustifolia, a very common plant in Utah and Arizona; the leaves yield the softest fibre of all the *Yuccas;* and, like all of them, is adapted to manufacturing purposes, especially for paper. The young flowering stems are used by Indians after the manner of asparagus; the same may be said of all the *Agaves* and *Yuccas*. They are eaten cooked or raw, and are not to be despised. The root is used after being pounded up as a substitute for soap.

Agave utahense.—The Pah-Utes strip the leaves from the heart

of the plants of this species, then heat stones, upon which the hearts are laid, the youngest leaves are next placed on, then weeds or grass, and finally, a coating of earth over all. This kiln remains three days, or until the contents are cooked, then it is uncovered. The hearts are either consumed as food immediately, or pounded fine, and pressed into flat, long, irregular-shaped cakes, about ten inches wide and fifteen long. They have a pleasant sweet taste, but the dirty black color might be objectionable to some. It is very nutritious, and the Indians of Utah become quite fat while living upon it. The tender inner leaves baked with the hearts are pounded and pressed by the hands into flat cakes, but are not so sweet or palatable as the hearts, and are full of fibres of a brown color. Its fibrous nature adapts these cakes for transportation. Indians in traveling or hunting, carry them tucked under their belts, and take off pieces as they go along to chew, spitting out the fibre or use it for gun wads. The hearts of all the *Agaves* when roasted yield this palatable kind of food.

A. deserti.—This is on the whole one of the most useful of natural productions to the Arizona, New Mexican and Lower California Indians. The heart of the plant after being roasted is a nutritious article of diet; from it is distilled a strong liquid called *mescal* by Mexicans; the seeds are ground into flour and eaten; the leaves are long and very fibrous and are cleaned like those of *Yucca baccata.* Sometimes after the leaves are dead and quite dry they are pounded until the epidermis is separated. The fibre thus cleaned is not so smooth and white as that soaked first in water, but very strong and durable ropes, mats, nets and sewing thread are made therefrom. This is a very abundant plant, covering many thousands of acres of land, unfit to grow anything more useful. A plant that contains so much fibre, surpassing in length and strength many other fibres in use for cordage and for paper, must some day be cultivated on the desert wastes of the United States.

A. shawii, one of the finest garden plants, but the fibre is only suitable for paper, being short. The Indians are very fond of a sweet honey-like nectar found in the base of its flowers; in fact it tastes like honey and water. It is only found near San Diego, California.

Willow trees.—Those along the Colorado river, Arizona, yield

abundance of long, soft bark, from which the Indians on this stream make ropes and twine for domestic purposes as well as sandals and mats. The females generally dress scantily, only that part of the body from the waist to the knees is h idden from view. This custom is observed by most of the Indian females living along the Colorado river. They strip off the bark from the willow trees and bury it in blue mud for a few days, after which it is taken out, washed clean and dried. It is now soft, pliable, and easily handled. Being cut into requisite lengths, they are fastened very thickly to a belt of the wearer.

The Colorado river Indians are said to make a fine drink from the flowers of the willows.

Apocynum cannabinum.—The Indians of Southern Utah, California and Arizona use the fibre prepared from the stems of this plant to make ropes, twine and nets; and before the advent of Europeans it was used in the manufacture of various articles of clothing. In order to remove the fibre the woody stems are first soaked in water, the bast with the bark is then easily removed. The latter being washed off, leaves a soft, silky fibre of a yellowish-brown color, which is very strong and durable. I have seen ropes made of it that have been in constant use for years.

Urtica holosericea.—The fibre of this plant is used by the Indians of Southern California to make their bow strings. In order to separate the fibre the plant has to go through the same process as hemp; its fibre resembling that of the latter, being equally strong and durable.

Cowania mexicana—This tree before the advent of Europeans was the great source from which the Nevada and Utah Indians obtained the materials for their dress goods. The outer bark is rough, but the inner is soft, silky and pliable, and of a brownish color. It is removed in long strips, varying in width, a desirable quality in a bark that is used in the manufacture of clothing, sandals and ropes. These articles were formerly made by braiding strips of bark together, or woven with the hand loom. Females made skirts from strips of this bark by braiding a belt to which they suspended many strips of the same material, hanging down to the knees like a long fringe; the rest of the person was naked in summer. Mats were also made from this bark which were used as beds.

Medicines.—Chlorogalum pomeridianum, common soap root of

California, and called by Indians and Mexicans *Amole*. It produces a large bulb which yields a great quantity of saponine, very good for washing, for which purpose it is much used by poor people and the Indians of California. The rough covering of the root is formed into bunches, tied up and used for hair brushes by the Indians.

Datura meteloides (Jamestown weed).—The California Indians make a decoction of this plant which is given to young females to stimulate them in dancing. After the root is bruised and boiled in water, the liquid, when cold, is taken internally to produce a stupefying effect, and is much used by California Indians.

The Pah-Utes call this plant *Main-oph-weep*. They bruise the seeds, soak them in water and expose the mixture to the sun's rays to cause fermentation. This being effected, the liquid is drank and has the same narcotic effect as the preparation made from the plant, or root with the alcoholic effect added.

Nicotiana trigonophylla, *N. bigelovii*, *N. attenuata*.—The leaves of all these species of *Nicotiana* are used as tobacco by the Indians of Arizona, Utah, New Mexico, and Southern California. The strength is said to be greater than that of the cultivated variety, though the leaves are smaller.

Ligusticum apiifolium, Angelica of the settlers of Utah, *Pah-net-snap* of the Pah-Utes.—It is a favorite medicine with these Indians. The root is bruised and used as a poultice for sprains and bruises. A tea is made from the roots and is taken internally for pain in the stomach. The Indians if afraid of catching contagious diseases fill their nostrils with pieces of the root. The strong, aromatic, carroty smell may have induced them to believe in the efficacy of this plant as a prophylactic.

Berberis aquifolium or *Oregon grape*.—From the roots of this plant a decoction is made in water, or they are steeped in liquor, and taken internally. It is a good remedy for general debility, or to create an appetite, and is considered equal to sarsaparilla in its medicinal virtues. It is a favorite medicine with the California Indians.

Anemopsis californica, *Yerba Mansa* of the Mexicans.—The root of this plant is a great remedy among the Indians of Arizona, and Sonora in Mexico, and Southern California. It has a strong peppery taste and odor. A tea made from the roots and a powder prepared from the same and applied to venereal sores are a great

remedy. The powder is advantageously used on cuts and sores, as it is very astringent. The leaves after being wilted by heat and applied to swellings are a sure cure.

Achillea millefolium, Yarrow of the settlers of Utah. The Pah-Utes make a tea from this plant and take it internally for weak and disordered stomachs. It is much used by Whites in the form of bitters.

Cucurbita perennis, called Chili Cojote by Mexicans.—The pulp of the green fruit is used with a little soap to remove stains from clothing. The roots of this plant are large and long, and when macerated in water are applied to piles, generally with good effect. The seeds are ground fine and made into mush and eaten as food by many Indians of Arizona and Southern California.

Euphorbia polycarpa, called by Mexicans Golendrina.—A strong decoction made from this plant and applied to snake bites soon produces reaction; many cures effected in this way are reported. In fact the Indians of Arizona and Southern California rely entirely upon it in such cases. Some years since, being in San Diego and wading in the salt water, a fish (*Sting-Ray*) plunged the bony projection at the base of its tail into my left foot and soon the swelling and pain became excessive; a Mexican woman made several gallons of a very strong decoction from this plant and plunged my leg up to the knee into it while hot, and in a few hours relief came.

Eriodyction glutinosum, *Yerba Santa* of the Mexicans, and a great medicine among the Indians of Southern Utah, Arizona, and California. A decoction made from this plant and taken internally for rheumatism and partial paralysis, or applied externally, is an excellent remedy. For affections of the lungs the leaves are used by smoking or chewing dry, or a tea is made from them and drank.

Micromeria douglasii, *Yerba Buena* of the Mexicans.—This is an interesting plant, growing near the sea coast of California, having a strong minty smell. It is a favorite medicine with the Mexican population of California. The Indians of the same section prepare a tea from it which is used for fevers and colds. In case of headache a quantity of the plant is bound round the head.

Artemisia tridentata, commonly called sage brush.—The Pah-Utes make a strong tea from this plant and take it internally for headache, colds and for worms. It is also a good stimulant, pre-

pared either with water or liquor. It yields a pungent oil which would be a profitable article of commerce.

A. filifolia, Southern wood.—This plant on distillation yields a very penetrating oil which is good for liniments, and the Pah-Utes make a decoction from it excellent for swellings and bruises.

A. ludoviciana, A. dracunculoides.—The seeds of these two species are gathered by the Pah-Utes, ground fine, made into mush and eaten. It is anything but a tempting dish, having a dirty look and strong taste.

A. ludoviciana.—This plant possesses medicinal virtues. The Pah-Utes make a strong tea of it and use it internally to assist child-birth, whenever assistance is required, which is seldom. In case of hemorrhage from the nose they stuff wads of the fresh plant into the nostrils.

Oreodaphne californica.—This fine evergreen tree of California has a very strong spicy odor. By rubbing the hands and face a short time with the leaves a very distressing headache will be produced. Hahnemann is not the only discoverer of the fact that like cures like; for long before he was born, the Indians of California were aware of the power which this plant had to produce a headache in those that are well and to cure those who are afflicted with it.

Erythræa venusta, a common remedy for ague by Indians and Mexicans of Arizona and Southern California. A tea is made of the plant and drank, and is certainly a very good substitute for quinine.

Pæonia brownii, by Mexicans called *Peo-neo.*—The root of this plant is used by the Indians of Southern California for colds, sore throats, and for pain in the chest. It is mealy and tastes somewhat like licorice. After being reduced to powder, it is either taken in that form internally or made into a decoction.

Grindelia squarrosa.—A decoction made from this plant is used by Mexicans and Indians of Southern California to cure colds. It is taken internally.

Lygodesmia spinosa.—This plant produces a short, fine, silky substance just at the juncture of the roots with the branches, which is used by the Digger Indians to stop the bleeding in gunshot wounds.

Perezia arizonica.—At the junction of the branches with the roots, and covering the greater part of the former is a soft, silky

substance which is used by the Apache Indians in gun-shot and other wounds, to stop hemorrhages, for which it is well adapted.

Glycyrrhiza lepidota, called by settlers of Utah, Desert root.—Pah-Utes eat it for its tonic effects. In taste it is much like licorice. Whites sometimes chew this root in place of tobacco.

Ephedra antisyphilitica, called *teamster's tea*, since men traveling with teams in New Mexico, Arizona and Southern California, camping among Indians, contract venereal diseases, and use this plant abundantly as a remedy, taken internally in the form of tea. A quantity of the plant is often taken along in case of need. This is a well-known remedy for gonorrhœa among many Indians and Mexicans. It is a strong astringent, and may prove valuable for its tonic properties.

Dyeing Materials.—Rumex hymenosepalus, a species of dock, is very abundant in sandy localities of mountain districts, and along river bottoms in Arizona and Southern Utah. Indians use the root for tanning buckskins. Moccasins made from leather thus tanned are rendered much more durable, and less liable to injury from moisture. It is also used in dyeing, as it yields a bright brown or mahogany color. Occasionally, Indians ornament their bodies by using this substance to form designs upon their limbs. Males especially, go more or less naked all the year round. The people of Utah use the leaf stem as a substitute for rhubarb to make pies.

Sueda californica.—At San Diego, California, it is commonly called glass wort, from the glassy brittleness of the stem. It yields much caustic potash, the ashes of which are used by soap makers. Indians gather the seed for food. The plant also yields a dark coloring matter.

S. diffusa, *Sah-ap-weep* of the Pah-Utes. The seeds of this plant are very small; nevertheless, they are gathered in great quantities. They are very difficult to clean, but the Indians are glad to obtain them. They are ground fine and made into biscuits. The seeds have a decidedly salty, potash taste. The flour tastes best when made into mush. The Coahuila Indians, of Southern California, make a fine black dye by steeping a quantity of this plant in water. For coloring their baskets black they take some mature rushes, and steep them several hours in this black dye, which is very penetrating, and the color is durable, but it has a very fetid, disagreeable smell.

Dalea emoryi, D. polyadenia.—Branches of this plant steeped in water form a bright yellowish-brown dye, and emit a strong rhue-like odor. The Coahuila Indians of California, to ornament their baskets of a yellowish-brown color, steep the rushes in a dye of that color, prepared from these *Daleas.*

Larrea mexicana, Tah-sun-up of the Pah-Utes.—It is one of the commonest plants of Southern California, Lower California, Arizona and Southern Utah. A lotion made by steeping branches of this plant in water, and applied to sores of man or beasts proves very efficacious, and a powder prepared from the dry leaves is good for chronic sores. From the old wood exudes an abundance of a gum which is softened and used by the Indians to cement their flint arrow heads into their shafts. The Apache Indians use this gum as a styptic. The settlers of Utah often use this plant in dyeing, as it produces a greenish-yellow color, and garments thus dyed have the curious property of emitting a very disagreeable, resinous odor ever afterwards upon being heated. In consequence of the peculiar odor of the fresh plant it is sometimes called creasote wood.

Garrya flavescens.—The fruit of this plant yields a violet coloring matter which is used by Arizona Indians. The leaves are used for ague and for colds, made into a tea and taken internally.

Trichostemma lanatum.—By Mexicans and the Indians of Southern California, it is called *Romero.* It is used by them to impart a dark or black color to the hair, and to promote its growth. A strong decoction is made of the leaves which is frequently applied to the hair. It is a very beautiful plant with bright blue flowers which emit a strong odor of hops.

Orthocarpus luteus.—This plant yields a delicate pink color, which is used by the Nevada Indians.

Eritrichium micranthum.—The slender roots of this plant yield a delicate yellow paint, used by Indians of Utah.

Lithospermum longiflorum.—The root yields a purple color; it is the Puccoon of the Eastern Indians.

Polyporus officinalis, a fungus which yields a reddish coloring matter which at one time was much used by Indians to paint their faces. Now vermilion is so cheap that it has to a great extent superseded this.

Evernia vulpina, a lichen which yields the highly prized

yellow paint found so frequently among the Western Indians. The Apaches of Arizona carry a portion of it carefully in a small buckskin bag. It is considered a charm when applied to the face, and a cross of this color on the feet enables them to pass their enemies unseen.

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THE MAPLE-TREE BARK-LOUSE.

BY EMILY A. SMITH.

THE fruit and ornamental trees grown throughout the country are affected more or less by insects belonging to the *Coccidæ* family, or as they are commonly known, bark-lice. The elm and maple are among the number, the former infested with a *Mytilaspis* and the latter with *Lecanium acericorticis* Fitch.

The first account we find of this insect is from Dr. Asa Fitch, of Salem, New York, in the Horticultural report of that State, in 1859, page 776. From that time nothing further was written until 1867, when Walsh and Riley, probably from oversight of the former article, together with figure 1, renamed the species as *Lecanium acericola* in the American Entomologist, vol. 1, page 14, since which time it has been considered under the latter name, but as Dr. Fitch has priority to the species, I would desire re-establishing the first name, *Lecanium acericorticis* of Fitch.

FIG. 1.—*a*, *Lecanium* on Maple; *b*, *Lecanium* on Osage Orange.

Throughout the eastern and western States this insect occurs quite plentifully upon *Acer dasycarpum* and *saccharinum*, and I have carefully studied its life history, which will be published in the Seventh Entomological report of

Illinois, now in the hands of the printer, from which this article is drawn. The illustrations are from the pencil of J. H. Emerton.

Mr. J. Duncan Putnam, of Davenport, Iowa, has given much time and study to the embryological development of this species; his valuable paper will appear in volume ii, part ii, of Proc. Dav. Acad. of Nat. Sciences, now in press.

During the winter months the females remain on the underside of the limbs in a dormant state (fig. 2, *a*), the beak inserted just under the bark. The greatest irregularity exists in reference to the position which they assume on the limbs, the bodies oftentimes overlapping each other, and when greatly crowded lying in opposite directions with the exception that they are always found lying lengthwise with the limb.

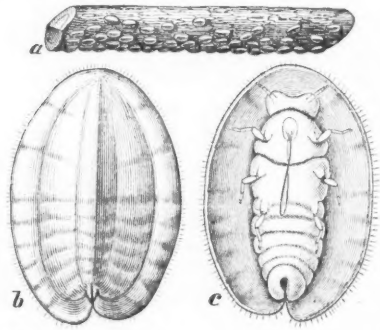

FIG. 2.—*a*, females on limb as in winter; *b*, dorsal view of female; *c*, ventral view of the same. *b* and *c* greatly enlarged.

They are at this time not over 2 mm. in length, much the color of the bark, oval in form and with a slit at posterior end; when raised from the limb the legs and antennæ are plainly visible (fig. 2, *b* and *c*). As soon as the sap commences to flow in early spring, with us near the middle of April, the insect absorbs nourishment from the tree and by the development of the eggs within the body becomes greatly distended. At this time small liquid drops are seen upon the ground and sidewalks underneath the fested trees, which is both sweet and sticky. This liquid issues from the pores of the body and continues until a waxy secretion is observed issuing from the posterior portion. This secretion issues from the general under surface but more particularly from the thorax and abdomen.

Projecting from the sides of the body can be seen, under a common lens, short thick hairs; from these points and from between the abdominal joints a portion of the waxy mass is secreted, but from around the anus comes the greater quantities.

In this cottony secretion the eggs are concealed, the work going on regularly, since we find the first eggs in the mass shortly

after it is perceived, and the insect continues partaking of the sap during the deposition. The secretion, at first is soft and sticky, but solidifies somewhat by contact with the air and remains perfect in form on the limbs after the eggs have all hatched (figure 3, *a*). A description is given below.[1]

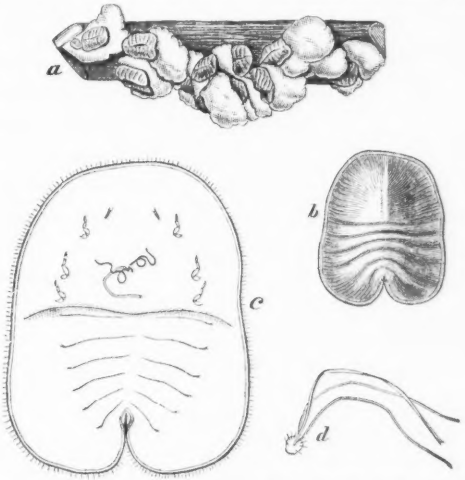

FIG. 3.—*a*, Egg mass of female; *b*, dorsal view of full grown female; *c*, ventral view of same; *d*, view of beak enlarged.

The first eggs appear about the end of May in this vicinity and are concealed in the waxy mass, the particles dividing them one from the other; these issue from the oviduct which has the opening at the posterior portion of the fissure. When the eggs first appear they are soft and pliable, but afterward harden, and as the embryos develop the color deepens. The eggs number from five hundred to one thousand, the deposition occupying from three to six weeks, the process being a gradual one. Some three weeks after the first eggs are deposited the first young lice appear and thus continue until all the eggs are hatched. The body of the female does not shrink in size as is observed in some species of *Coccidæ*, but continues absorbing nourishment until the ovisac is emptied, when she withdraws her beak from the limb and dies,

[1] *Lecanium acericorticis* Fitch, fully grown female. Dorsal view. Oval with dorsal convex carina; an anal fissure at extremity. Three thoracic and seven abdominal segments. Margin furnished with short bristly hairs. Eyes absent. Oviduct situated at end of posterior fissure. Color somewhat lurid with numerous dark blotches, the lines separating the segments darker.

Ventral view.—Antennæ and legs visible but small. The beak arises from a tubercle situated at the extreme end of the head which forms a projection extending slightly over the thorax. The beak itself is a long thread-like organ composed of four distinct pieces. The first pair of legs are nearly opposite the beak, the head and thorax occupying over one half the entire insect. Opening of oviduct at end of fissure. Length 5 mm.

the dead body remaining attached to the limb by means of the cottony secretion. Athough the antennæ and legs do not develop in the same degree with the body, they are not entirely useless, since by removing a grown female in the spring from the limb the insect will move slowly, even though in their natural condition they cease all movement after settling down in the autumn upon the limbs.

The young lice first appear about the middle of June, and are more than twice as long as broad. They are light sordid yellow, translucent, elongated-oval, tapering slightly toward the posterior end, with seven abdominal segments,the division lines being darker and plainest in the middle. Short hairs project from around the margin at regular intervals.

The antennæ and legs are situated some distance from the margin and are inserted on the underside of the body. The antennæ are armed with several strong spines and are jagged in outline. The legs are stout, terminating in a single curved claw and four knobbed hairs.

The beak is a long thread-like organ, very minute, and until the young louse becomes stationary is folded in a loop in the abdomen. At the end of the abdomen, arising from tubercles, projects two anal appendages or setæ longer than the entire body which disappear in a short time. In the natural condition the young insects settle down upon the leaves of the maple within three days after hatching, the preference given the underside and near the midrib, although they are found upon the upper side to some extent, probably because the epidermis is more tender on the under side and they are there protected from the sun's rays. The beak is at once withdrawn from its retreat and is inserted in the leaf, when the insect increases rapidly.

When in a state of rest the young lice draw the antennæ under and parallel with the last joint of the fore pair of legs. The two remaining pair extending backward.

Although they seldom leave the first assumed position until autumn, they have full use of their legs, since when the leaf is detached from the tree, the young lice will withdraw their beaks and move quite actively about in search of fresh food. When first hatched the males and females are not easily distinguished from each other; they soon, however, present quite a difference, the males becoming longer, lighter in color and somewhat higher than the others, and two anal setæ are seen projecting

from the scale. This occurs during the last week in July, and although no regular or sudden transition takes place, yet during the fore part of August the males appear, leaving behind the empty larval scales on the leaf, which are easily seen scattered about among the females upon both upper and lower sides of the leaf.

The male louse is very different from the female. During the transformation he has acquired wings for the new sphere into which he is about to enter, although he still retains the legs and antennæ, the beak is abortive, its place represented by two round spots. The three parts, head, thorax and abdomen are easily distinguished. The first males were observed August 13th, 1877, and continued appearing over two weeks. They are very active, flying about the leaves with great rapidity. At this time coition takes place, and the ovaries become developed in the impregnated females, which remain on the leaves drawing sap continually during the entire summer.

The Male-Louse.—Comparatively few of the male-lice have as yet been discovered by entomologists, and it was with pleasure that the male of *Lecanium acericorticis* Fitch was found during the summer of 1877. Their existence is for a brief period, since they are not found longer than three weeks in the year; the probable life of each individual not being over a few hours. While the female is destined to remain upon the tree during its entire existence—a few weeks over one year—the males acquire wings and fly about. That the males are necessary for the perpetuation of the species is doubted by some authors. I made an estimate of the number of larval scales on several leaves, and on the trees which had suffered a longer time, and found the average number to be greater upon a much infested and thus diseased tree than upon a healthy and vigorous one upon which the insects had not been so violently destructive. It often happens that a maple-tree will suddenly revive and outgrow the injury of these insects to an extent, even when no attempt has been

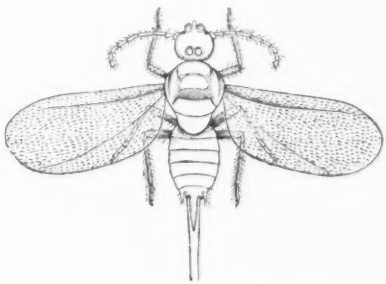

FIG. 4.—*Lecanium acericorticis*, male.

made to exterminate them. Whether this is due to the greater number of the young lice proving to be males or from the effects of parasites remains to be determined.[1]

Wings membraneous, hyaline, dotted with short points extending outward, sending out at the base a forked line, one toward the upper, and one toward the lower margin. Mons. V. Signoret says in his essay on *Lecanides*, that in the place of the lower wings of the male there are two halters or balancers, which I have been unable to discover in the mounted specimens before me, although it is quite possible that they may be found in fresh specimens. The females continue absorbing nourishment during the remainder of the summer and return to the limbs at the approach of frost in the autumn. In Fig. 1, Mr. Riley has illustrated the egg-mass as occurring upon the leaf, which is contrary to my experience in Illinois and Iowa, although were the season longer it might be the case, and thus become double-brooded since it is well known that the varied temperature has great effect upon the length of time insects remain in their several stages.

Three kinds of Lady-birds (*Coccinelidæ*), are found more or less numerous upon the infested trees destroying the *acericorticis* during the summer months. The *Hyperaspis signata* Olivier is perhaps the most abundant and valuable. The larva is small, light colored, and covered with a peculiar white downy substance. They are found inside the waxy mass devouring the eggs, and through their assistance many are thus destroyed before hatching. The outside of the egg-mass appears entire, but by carefully separating it, the larva can be observed, in the act of devouring the contents of the egg, by the aid of a common lens. Only one larva is found in each egg-mass. When fully grown and about to change to the pupa state, they emerge and attach themselves to the tree. The imago is a small black beetle with one bright red spot on each elytra.

The *Chilocorus bivulnerus* Muls. (Fig. 5), although not found in such numbers as the *signata* are equally as important since they

[1] *Lecanium acericorticis* male, see Fig. 4. Color fuliginous, with the thoracic segments darker than the remainder of the body. Head small, angular in front, and at the sides. Antennæ 10-jointed, filiform, pubescent, fourth, fifth and sixth longest. Color light brown. There are two ocelli between the antennæ. Thorax large, the mesothoracic band distinct, shiny, the metathorax forming an arched shield extending a short distance over the abdomen. Legs stout, sparsely covered with hairs, tarsi furnished with two claws at the end. Abdomen ends in a tubercle which protects the penis, the entire nearly half as long as abdomen.

destroy the young lice. The larvæ are readily recognized from the larvæ of the former by being covered with a large number of black spines, they are considerably larger, and are not found inside the egg-mass. They are ravenous feeders, and require a great number of lice before they complete their larval state. The imago resembles the *signata* in color, but is much larger and equally voracious with the young.

The *Anatis* 15-*punctata* is also beneficial in its destruction of the *acericorticis*, and is larger even than the preceding ones, but does not occur so plentifully.

The larvæ are furnished with six rows of stout spinulated spines along the body, the upper surface of which is black, while beneath it is pale, and is nearly half an inch in length. The beetle is black on the head and prothorax, having seven black spots on the brownish-red elytra, and a black spot on the scutellum; it is seven-twentieths of an inch in length.

The larvæ of a species of *Chrysopa* are found assisting in the work of destroying the enemy, but not in any considerable numbers, as also two species of *Reduvidæ* and one *Acarus*.

The females are destroyed by means of a parasite which live upon the fatty substance without disturbing the vital organs, and only destroys the insect when changing to the pupa state inside the body of the other from which it emerges through a cylindrical hole on the dorsal side. This parasite is double-brooded, the second brood appearing the middle of August. The insect belongs to the genus *Coccophagus*, thanks to Mr. E. T. Cresson for its determination, and appears to be undescribed (figure 6).[1]

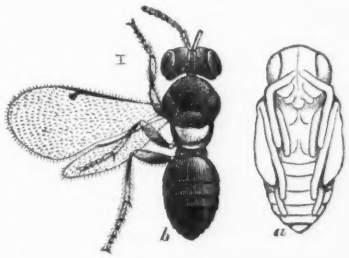

FIG. 6.—*Coccophagus lecanii* nov. sp. *a*, pupa; *b*, imago; hair lines natural size.

[1] *Coccophagus lecanii*, nov. sp. Fig. 6. Body elliptical oval; color cinereous. Head as broad as the thorax, smoky brown in color, and pubescent. Antennæ eight-jointed, first joint longest. Thorax nearly black, with a crescent-shaped spot of pale yellow placed crosswise upon the hind part of the thorax. Abdomen elliptical, a little longer than the thorax. Legs light brown with the femora darker, hairy, furnished at the apex of tibiæ with a spur; tarsi five-jointed, first joint longest.

Wings membraneous, hyaline, ciliated. Fore wings with the rib vein running parallel with the margin nearly one-half its length, where it unites and ends in a stigma somewhat beyond the middle. The lower wings smaller, without veins, the hairs forming a fringe on the lower side.

THE FIRE-FLIES AND THEIR PHOSPHORESCENT PHENOMENA.

BY MRS. V. O. KING.

THE most interesting feature distinguishing these insects is their phosphorescent qualities. Light, so universal in its influences upon the life processes, and made familiar to us through the multiform media of its evolution, is known to result from a combustion of dead matter. To this known fact, *Lampyris*, creeping and flying, and at the same time emitting light, would seem to present a contradiction.

This singular fact early attracted the attention of naturalists and philosophers. A traveler in Japan, about the middle of the 15th century, studied its phenomena, discovering two kinds of light; and later, Mr. McCartney, by anatomical investigation, found two vesicles from which he supposed the more permanent light to proceed. Similar discoveries were made about the same time by a Polish naturalist. Many distinguished entomologists have given attention to the subject; even Arago studied the character of the light in connection with that of the sun, and found it to exhibit the same species of refrangibility with the light of that body.[1]

Matteucci, who studied this phenomenon from a chemical standpoint, concluded that there was positively no phosphorus present in the luminous segments, and therefore accounted for the manifestation by other means.

Prof. Pancerri of Naples, a few years since, concluded that phosphorescence in animals is the result of oxidation of certain fatty material, composed partly of epithelial cells in a state of partial decomposition, a manifestation (as Draper also says) of dead matter only; due to a slow combustion by which vibrations are excited capable of transmitting luminous rays. This phosphorescent substance, Pancerri finds secreted in glands in all cases except noctulica.

[1] The spectrum given by the light of the common fire-fly of New Hampshire (*Photinus ?*) was found by Prof. C. A. Young to be perfectly continuous, without trace of lines either bright or dark. It extends from a little above Fraunhofer's line C in the scarlet, to about F in the blue, gradually fading out at the extremities. This portion is composed of rays which, while they more powerfully than any others affect the organs of vision, produce hardly any thermal or actinic effect; in other words, very little of the energy expended in the flash of the fire-fly is wasted. Prof. C. A. Young in the AMERICAN NATURALIST, Vol. iii, p. 615.—EDITORS.

I have examined many of the Lampyridæ; the phosphorescent segments in the highly organized species contain a translucent substance resembling half-cooked starch, situated just behind a yellow waxy-looking membrane. This membrane has, on its ventral aspect four distinct spiracles for the admission of air.

Through these spiracles and contiguous parts may be seen at times quick brilliant flashes of light, made more rapid and vivid when the insect is handled, and followed in its normal state by a milder emanation, which may be compared to the embers of the previous conflagration. This second light is yellowish and dies out slowly. The first appearance of fire-flies in the twilight is indicated by a red, followed shortly by yellow, and later by the characteristic green light.

Different species vary in the degree of activity and also somewhat in the manner of emission. The phenomenon is also subject to changes during the metamorphic period.

The larva in *Photinus* emits a steady green light from the posterior segments on the ventral surface. The pupa light, at first green, soon assumes a whiter less brilliant character, diffused over the entire body.

The imago of the apterous female of *Pleotomus* exhibits greater intensity, and over a larger surface than in male forms, but steady, and at times disappearing from the posterior segments to be diffused as a white light over the body. This insect is scarcely more than an egg-bag, and its light is never so green as in other species. There is almost as great a diversity of degree and manner as of varieties, each enabling the observer to identify them at night.

A peculiar odor is perceptible, at times, in fire-flies. An English writer first noticed this, but afterwards concluded that he might have been mistaken.

The soil which is most frequented by glow-worm larvæ consists largely of decomposed rocks, and produces a growth whose ash is intensely sulphurous to the taste. In these places may also be found earth-worms filled with phosphorescent matter, and snails, the favorite food of the glow-worm larvæ, while the *Primula mexicana*, the vegetable diet of adult winged species, also abounds. All these features obtain in a moist soil and open air of fields, where, according to Ebermeyer, ozone is found in greatest quantities, and oxygen its other form.

A calcium sulphuret of phosphorus, prepared by heating sulphur with calcined oyster shells, is said to give out a yellow light when exposed to the sun's rays, but under decomposed light there is a change to green. The decomposition of certain rocks furnishes phosphates of calcium to the soil, whence having been appropriated by plants it eventually supplies animals. When not oxidized in the stomach it is supposed to be absorbed into the system in certain oils. Phosphorus in its active state ignites spontaneously in contact with the air.

In *Lampyris* we see changes identical with those presented by a calcium sulphuret of phosphorus from the red or yellow to green.

The emission of the greatest amount of light would also point to the presence of phosphorus, this occurring most freely in the open air, and when the insect is either flying or excited, when the body is presumed to be most fully inflated with air, the spiracles on the luminous segments being very favorable for its admission.

The second light, referred to as of a milder kind and with a steadier emanation, would seem to be portions absorbed by the translucent substance during the more active evolution of light, and reflected from the less permeable inner face of the dorsum until exhausted.

The uses of the light of *Lampyris* seem as doubtful as its nature. As it cannot be of service in the larval state either for sexual attraction or to secure food, its presence at this early period must be for the benefit of succeeding stages, and especially for the imago in the case of the apterous female.

The periodicity of the phenomenon may be ascribed to that property of the ganglia which enables them to give a periodical exhibition of an original disturbing cause.

There is a definite relation between the proportion of light emitted, and the color of the enclosing membrane which indicates the former's bleaching power.

Draper illustrating a truth says, that "not a shadow falls for an instant upon a wall but it leaves an ineffaceable stain," thus by his shadows bringing the power of light into bold relief. If a ray of light falls, however softly and but for an instant, upon an object, we may presume that a change, whether by chemical or mechanical means, ensues. Flowers and fruits by their irregular surfaces break the sunshine into specific hues, thus acting as shadows to themselves. Animals also respond in coloring to the influence of light.

In *Lampyris* the almost perpetual play of light, generated and partly confined within the posterior segments, has probably conduced to their final change of color. Ozone, of whose presence there is a suspicion, possibly exercises its bleaching power here as in vegetable tissues.

Assuming that the phosphorescent material is accumulated in the larval and preserved in the pupal stage for the final form, there are certain ways in which it might be useful at this latter period. The apterous female, being without food, must generate sufficient heat, from internal resources, to sustain life through oviposition.

The winged species may also utilize this power to decoy victims, and also to betray their presence to the carnivorous species, while others may kindle the torch of Hymen by this veritable flame. That both sexes possess phosphorescent properties is not surprising, since both are the product of a luminous stock, but we may expect a greater degree of phosphorescence from the female, and facts sustain this expectation.

Thus our insect seems eminently conservative in its powers, while combining the useful and the beautiful in its physical gifts.

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PHYSIOGRAPHY.

BY C. LLOYD MORGAN, F.G.S., A.R.S.M.

THE artist who is illustrating a great theme upon a large spread of canvas finds it necessary from time to time to lay down the brush, with which he is accurately filling in the more delicate minutiæ, that he may retreat to a distance and view his picture as a whole. It is essential to the higher development of his art that he should not omit this comprehensive survey. The same thing holds good in literature and science, as well as in art. The historian must, from time to time, take a fresh survey of history as a whole. If he neglect to do so, the group of figures to which he devotes his special attention will certainly not take up its true position among the other groups that appear on the canvas of history. The man of science, also, should not forget that he is, according to his individual bent or capacity, aiding in the construction of a great philosophy; and he should now and again turn aside from the microscope, or lay down the hammer, to take a

more comprehensive survey of that philosophy, whose aim it is to comprehend and consolidate the widest generalization of science.

A rude attempt at such a survey of the principles of geology and the bordering branches of science will be found in the following pages. They are from the notes of a lecture which formed the last of a course delivered before a school audience. In that lecture I did my best to give a rough sketch of that chain of events by the study of which we may build up a history of the Earth, while I endeavored at the same time to lead my hearers upwards from the simple to the complex ; for I hold that the teacher of science should lead his pupils from the well known, through the less known, to the unknown. Taking a few simple and obvious facts as a basis, he should first test whether those whom he teaches really know them to be facts, and then, carefully building upwards, seeing that each stone of his superstructure rests securely on one which has before been firmly laid down in its true place, he should mount slowly and surely, until, at last, he reaches that rare atmosphere of the unknown in which, for the present at least, no man may build.

Standing by the sea-side, then, let us inquire of Nature concerning the things which we see around us. The waves roll in upon the shore, the wind blows freshly in our faces, a heavy storm-cloud hangs over the distant horizon, at our feet is a little streamlet running over the sands to the sea ; behind us is the white chalk cliff, capped with sand and clay.

How come these waves, and what are they doing ? shall be our first question. The answer to the first part of the question is so obvious that a child will not hesitate to reply, that it is the wind which produces the waves. At first a mere cat's paw on the surface of the sea, the growing ripples are, as the wind continues, hurried onwards, increasing both in length and breadth, and, where the water is deep, in velocity of motion, until they become the great waves, some fourteen feet high from trough to crest, which we see on our coast during a storm, and finally, if they have a fair field, develop into ocean billows, twenty-six feet high in the Atlantic, forty feet high in the Southern Ocean. In the open sea the water is not carried forward by this wave motion. We may watch the sea-bird rise and fall as the wave passes under her. She is not carried forward on its summit. But when the wave

reaches shoal-water, in the neighborhood of land, the lower part is retarded by friction against the bottom, while the upper part hurries on, and the wave breaks, and rushes up the shore, the under water racing back and tearing up the beach in its backward course. It is in this way that the sea has such power in grinding down the rocky materials which fall to the base of our island cliffs. Along the Chesil Beach the pebbles are carried forward fifteen miles by the action of the waves, and as they grind over each other in their westward course, they become smaller and smaller.

Here then we obtain an answer to the second part of our question: What are the waves doing? They are beating backwards and forwards the matter which falls from the cliffs, until it is broken up and rolled into a rounded pebbly beach. But they are doing more than this. They are battering at the cliff itself, and aided by rain, and frost, and wind, are eating away our island shores. The force with which the waves dash against the cliffs is at times enormous, having been known to reach a pressure of more than three tons on the square foot. During the hurricane which swept over Barbardoes in 1780, cannon which had long been lying sunk were washed far up on the shore.

In some parts of England the sea is advancing rapidly on the land. Prof. Huxley, in his excellent little book on Physiography,[1] quotes, as an instance, the fact that Reculver church, which in the time of Henry VIII, was a mile from the sea, is now only preserved from the destructive action of the waves by a stone breakwater made by the Trinity Board. Not long ago, I walked along the coast from Herne Bay to the Reculvers. The rapidity of the waste was clear. In many places portions of the path had been carried away. Masses of grass-covered earth, lying at the foot of the vertical portion of the cliff, showed how recent had been the precipitation from above; while the clean-cut face of the cliff, and the sharp forms of the projecting ridges and pinnacles of the clay showed that since they were left in their present position, they had not suffered for long the attacks of rain and wind. Great cracks at the surface, here and there, showed that destructive action was still in progress; and when I looked at the lately fallen blocks of earth below, I felt that it was possible that the grass tufts, on which I stood, might be the next to fall amidst the

[1] 8vo. pp. 384, with 5 plates and 122 woodcuts (Macmillan & Co., London, 1878).

ruins beneath me. But though the action of the weather was thus clear, the sea-waves, which alone permitted that action to continue, were not idle. The brown color of the sea for some distance from the shore gave evidence of this, and while I stood upon the beach, I saw several projecting blocks of clay wasted by more than half.

In Scotland and Western England, where the rocks are hard, the advance of the sea upon the land is quite imperceptible. All the beauties of our coast scenery, our bold headlands and sweeping bays, result from this *unequal* action of the sea upon the harder and softer rocks of which our island is built up. But little observation is necessary to make it clear that, along any coast-line, the promontories are composed of hard rock, the bays of a softer material. Sea-side scenery is, therefore, a joint product of wave action and the geological structure of the coast. We must not forget, however, that it is only along its margin, where it beats upon the shore-line, that the sea is an agent of *denudation*. Throughout its great extent the ocean is the area of deposit and construction, just as the land is the area of destruction and waste. Beneath the sea the products of that waste come to rest. Strange as it sounds, the sea is the cradle of the land. Beneath the waters of the ocean are formed those layers of sediment which will some day be raised above the waters to form the framework of new continents.

From the answer to our first question, then, we learn that the waves are advancing upon the land, and thus producing our coast scenery, and that they are caused by the winds.

Let us next consider the streamlet at our feet. What is it doing, and how comes it here? That little streamlet, if we will but listen to it, can tell us much about what the great rivers of the earth are doing. Let us learn from it. In the first place, then, we see that this miniature river[1] is gradually changing its course. The main current strikes against one bank more than the other. The result is that this bank is forced to recede. Its tiny cliffs are undermined by the action of the stream, and the upper portions, now and again, topple over with a little splash into the water. Here we have in miniature that which may be seen on an enormous scale on the Mississippi and the Amazons. Large vessels may there be made to rock by the waves created by the fall of

[1] Miniature Physical Geology, *Nature*, March 8, 1877.

great masses of the concave bank, the river having in this way advanced upon the land hundreds of yards, and, in some cases, even, several miles, within the memory of living men.

This shows how a stream cuts its way *sideways* into the land. This is not, however, the most important part of what a river does. If we follow our stream a little way inland, we shall discover that it cuts its way *downwards* and cuts it way *backwards*. Both modes of action go on, as a rule, at the same time; but sometimes one, sometimes the other, is most obvious. Of the first, the Cañon of the Colorado offers an example on the grandest scale. This great ravine is about three hundred miles long and, in places, *more than a mile* deep. There can be no doubt that it has been entirely cut down into the desert plateau by the action of the river. How this was effected we learn, to some extent, from the following sentence in the American report on the river, "The water of the Colorado," says the reporter, "holds in suspension a large amount of fine siliceous sand, sharp as emery, that eats away the valves" (connected with the machinery of the steamer) "as rapidly as it could be done with a file." It has probably been with the aid of this sand that the river has cut down its deep trench.

Of a river cutting its way backwards, the Niagara is the grandest example. At the Falls the water tumbles over a ledge of limestone which rests on a thickness of shales. By the action of the spray which rises from the waterfall, and partly by the power of frost, the shale is rotted away, and thus the limestone is undermined. It is in part owing to the undermining action, that visitors can proceed a little way under the Falls. To do so is well worth a wetting; a whole river takes its mighty leap, and falls with a bewildering roar at your very feet, and if it be winter giant icicles hang above your head. When the "under-cutting" has gone on for a certain time, huge blocks of the limestone tumble with a crash to the base of the waterfall. In this way the Falls of Niagara are working backwards, at the rate of about one foot a year, towards Lake Erie. Only the other day it was stated in *Nature* that, on November 17, 1877, a large section of the rock towards the Canada shore fell with a tremendous crash, and that during the night a still larger area went down.

But what becomes of all the material dug out by the stream as it cuts its way sideways, or downwards, or backwards? If we

watch any little rill which falls into a pool on the sea-shore, we shall soon find out. We shall see that the sand and other material which it carries are built up into a little delta, while some of the finest material is spread at large over the bottom of the pool. Large rivers carry vast quantities of mud and sand and silt (much of which is washed off the land by the rain) to the sea. Experiments of mine on the Thames, at Surbiton, show that in fine weather, when the river was low and fairly clear, solid matter in suspension was being carried seawards at the rate of 9767 tons per annum; while, when the river was in extreme flood, matter at the rate of 524,940 tons per annum was passing in this way down towards the sea. With the great rivers of the world of course the amounts are still more enormous. Sir Charles Lyell calculated "that if a fleet of more than eighty Indiamen, each freighted with about 1,400 tons weight of mud, were to sail down the Ganges every hour of every day and night for four months continuously, they would only transport from the higher country to the sea a mass of solid matter equal to that borne down by the Ganges in the four months of flood season." All the matter carried down in this way is built up, layer upon layer, into a vast delta deposit, or strewn over the bed of the ocean. Of such layers much of the crust of the earth, the sand and clay at the top of the cliff behind us for example, is composed.

But besides the matter carried down by rivers in suspension, a vast amount is carried down in solution. Take the Thames for example. For every grain transported mechanically, more than twenty grains are carried down chemically. Every gallon contains some twenty grains of lime salts, and about two grains of common table salt, or chloride of sodium. These also are carried out into the sea, in which the chloride of sodium, along with certain other salts, accumulates on the evaporation of the water, and thus forms the brine of the ocean, while the carbonate of calcium is separated by living creatures and built up into some sort of pure limestone. Of such limestones also much of the crust of the earth, the chalk of the cliff behind us for example, is composed.

We have thus seen what the streamlet is doing. It is aiding the rivers of the world to carve out valleys, and it is carrying seawards the fine mud and sand which result from its own work and that of rain, to contribute to the framework of a future continent.

And how comes it here? Directly or indirectly from rainfall. Whether its source be a spring, or the collected waters from a sloping hill-side, it matters not. Without rainfall, such as is now pouring from the distant storm-cloud, the streamlet could have had no existence.

Another question therefore suggests itself: What is this rainfall doing, and how comes it here? If we walk along the shore for a little distance, we may perhaps see (if there is beneath the cliffs any clayey material containing flat stones) small pillars of earth, each capped by one of these flat stones. These are little monuments of rain action. Rain falls upon the surface and runs off towards lower levels; as it runs, however, it carries with it a little of the fine clayey material. Thus it lowers the surface. But where there is a flat stone, the surface is protected from the softening action of raindrops, just as a house is protected by its roof. The soil beneath the stone is not carried away, and the miniature earth pillar stands out as a monument. In Switzerland there are, in several places, earth pillars fifty or sixty feet high, which have been formed in this way.

But it is not only where there are earth pillars that the rain is exercising a denuding action upon the land. If we go out into the fields on any rainy day, we may watch how the soil is literally flowing downwards to the sea. Few fields are perfectly flat, and the rain which falls upon the surface tends to drain off at the lowest possible level. But if we examine the water which is thus on its way down the field, we shall at once see that it is not clear, that it carries with it some of the soil. Much of the rain, of course, sinks into the ground. But before it does so it is nearly sure to trickle a foot or two over the surface. Even if it only runs a few inches, it must bear with it some of the soil for this distance, and there leave it. If the rainfall continue, the soil is soon carried a few inches further; and it always travels in one direction from higher to lower levels. Our field may be separated at its lower end from another by a wall, which will check the downward progress of the soil. If this be so, we shall often find that, from the accumulation of this soil, a child may look over the wall on that side of it which faces up hill, while a full-grown man may have to stand on tiptoe to gain the same advantage on the lower side. Or perhaps at the bottom of the field there may be a ditch; that ditch may communicate with a streamlet, and the

streamlet fall into a river. Some of the soil of the field is thus carried by every heavy shower of rain into the ditch, and thence into the river. After a wet day we shall find that all the tiny rills, the little rivulets, the streams, and the great rivers themselves, are muddy and thick. This mud is nearly all derived from the soil of the land which lies in the river-valley. Thus the land is always flowing downwards to the sea; not a particle can get up again when once it has flowed even a few feet in its downward course; and this action is going on wherever rain falls upon the surface of the land.

But though the surface layer is, in this way, being constantly washed off the fields, the soil does not lessen in quantity. For as fast as material is carried away by the rain, so fast does the same agent, aided by weathering action, prepare fresh soil, to be treated in a similar manner. At the same time we must remember that, though the amount of soil does not grow less, the amount of land above the waters of the ocean does diminish. Does this seem strange? A rough analogy may serve to make it clear. A man possesses a certain amount of money, most of which is in the bank, and a small amount for immediate use in his waistcoat pocket. As fast as his ready cash disappears he draws a check on his banker, and in this way his waistcoat pocket has a more or less constant supply. Practically speaking, therefore, his ready cash does not diminish, though his balance at the bankers does not remain equally constant, but decreases day by day, at a rate which would shortly lead to bankruptcy if he were not careful that there should be a supply equal to the demand. Now the soil is the ready cash, and the strata of England the balance at the bank. Rainfall is continually tending to diminish the amount of soil or ready cash, which is made good by a fresh supply from the bank. It is perfectly obvious, however, that the balance at the bankers must decrease, and that in the course of ages England must be entirely washed away into the sea of geological bankruptcy unless the bank receive a fresh supply; unless, in other words, by the force of elevation, fresh land be raised from time to time above the waters of the ocean.

With regard to the influence of rain on the physical aspect of a country, it may be said that viewed on a large scale and in a general way, this agent exercises a softening effect on scenery; in those areas where the strata are of a soft and easily yielding

nature, the work of rain as an earth-sculptor is to cause the land to assume a gently undulating form, and to extend in *breadth* those valleys which rivers are always tending to extend in *depth*. On those rocks, however, which are of a harder nature, rain has less absolute power, but even here it renders the scenery less rugged; less sublime perhaps, but more beautiful.

And how comes this rain? We know that it falls from the clouds. We know too that these clouds are formed when the air above is cooled so much that it can no longer hold in solution all the vapor of water which it has borne in an invisible form from afar. The rain, therefore, comes from the vapor of water existing in the wind. And how comes it to exist in the wind? It is obtained from the Atlantic Ocean. Thither then we must travel in thought and try and picture to ourselves what takes place when the visible liquid water is converted into the invisible gaseous vapor of water. Now it is quite evident that some force is overcome—some binding force which drew the particles of water closely together. This force is cohesion. It may be likened to a strong man who holds the watery particles in bondage, not indeed so severe as that of the terrible ice-king of the Arctic and Antarctic regions, for they are allowed free motion among each other and are not locked in the solid state, but still *bondage* chaining them down to the limits of the ocean. This strong man will not loose his grip until he be conquered by a stronger than he; and on the Atlantic he meets with that stronger man whom we call heat.

Sun-heat sets free the particles of water from the bondage of cohesion, and allows them to escape into the air. But the mastery is not gained without an effort, and the value of this effort has been calculated. To emancipate nine pounds weight of water particles, an amount of energy has to be expended, equal to that of lifting a ton to the top of a precipice 2900 feet high.[1] But just as, when two wrestlers struggle together, neither can master the other without a true waste of his substance taking place, a waste that has ere long to be made good by the absorption of a certain amount of mutton or beef, so too on the Atlantic, during the struggle between cohesion and heat, a certain amount of the latter is consumed and disappears. The amount of heat so expended has also been calculated. In setting free nine pounds of water particles an amount of heat disappears sufficient to fuse forty-five pounds of cast iron.[1]

[1] These are two different ways of stating the *same* fact.

To take leave of metaphor, this amount of heat is expended in overcoming cohesion and tearing asunder the particles of water. The vapor particles thus formed, kept separate from each other by heat, are carried by the wind to our shores; there the air in which they float is cooled; the heat is now insufficient to overcome the force of cohesion, and the water particles, no longer held apart, clash together, and as they do so they generate by the shock as much heat as was expended before in tearing them asunder. All the heat which disappeared—was rendered latent or hidden—when the vapor of water was raised from the Atlantic, is set free or rendered sensible when condensation takes place. For every nine pounds of weight of cloud formed in our skies, an amount of heat is set free sufficient to melt forty-five pounds of cast iron.

A valuable lesson may be learned from this behavior of water and water vapor. When the liquid water became gaseous vapor a certain amount of heat energy disappeared. But it was not destroyed. It was converted into another form of energy which we may call the energy of separation. The particles were forcibly *separated* from one another, and a certain amount of energy was necessary to keep them apart. Presently, however, they clashed together again and the energy of separation was reconverted into the energy of heat. The amount of heat given out was exactly equal to the amount of sun-heat absorbed. Day by day fresh experiment and observation make clearer this great law of nature: that by no means at our disposal can we either destroy or create energy. We may change it in a number of ways. We may convert chemical separation into electricity, this into mechanical motion, and mechanical motion into heat. But we can neither call into existence or put out of existence any portion of the energy of the universe, any more than we can call into existence or put out of existence any portion of the matter of the universe.

One more fact must be noticed. Though the same amount of heat is given out by the condensation of the aqueous vapor as was absorbed on the Atlantic during its formation, it is no longer useful in the same way. It does not possess the power of again converting water into water vapor. It has become degraded. It is the same in amount, but different in value. The water which turns a mill is the same in amount whether it lies above or below the water-wheel, but it differs vastly in value. That above the

mill is useful to the miller, that below the mill is useless. It is the same with energy. Just as water tends to run down from higher to lower levels, so does energy tend to run down from higher to lower forms. All forms of energy tend to be degraded to heat uniformly diffused throughout space.

To the energy of sun-heat, then, we owe the existence of vapor of water in the wind. And to what do we owe the wind itself? To the same cause. On any winter's evening, the colder the better, we may make the following experiment, first performed by Franklin: When the dining-room is warm but the hall outside cold, we may throw open the door to its full extent. On holding a lighted candle in the doorway near the top, we shall find that the flame is blown outwards; on holding it near the bottom, we shall find that it is blown inwards; midway between the top and the floor the flame will burn steadily. The cause of this is obvious when we remember that warm air is lighter than cold air. When the door is opened warm air rushes out near the top, and to supply its place cold air rushes inwards along the floor. The two currents are divided by a calm.

At the seaside we may watch the same sort of experiment performed on a larger scale by nature. In settled summer weather sailors count on a sea-breeze in the morning, and a breeze from the land at night. The cause of these land and sea-breezes, with which every yachtsman is acquainted, is simple. In the morning the sun shines alike on land and sea, the land, however, most readily takes up the undulations of heat. The air above the land thus warmed expands, and forms an upward current, while a refreshing breeze comes along the surface from the sea, just as a cold current passed along the floor from the hall.

At nightfall the reverse is the case. The sun withdraws his rays from land and sea; but the land, which was the first to be heated in the morning, is the first to cool in the evening. Soon it is as cool as the sea. Ere long it has become colder than the sea. And the current now sets outwards from the land. We have changed the conditions. We have brought a refrigerator into the dining-room, and the lower cold current now sets outwards into the hall. It is, of course, under ordinary conditions, only the under current which we on the earth feel. The upper current is far above our heads. A French balloonist (Tissondier) rose from Calais into the upper current, and was carried far out to sea; on

descending he entered the under current, which bore him safely back to Calais.

The same laws are seen in operation in the Indian Ocean. There for half the year the North-east Monsoon which blows *from* the continent of Asia is the prevalent wind. During the summer, however, it is forced back by a South-west wind, caused by the great upward draught over the glowing plains of Central Asia.

Far away on the broad Atlantic and Pacific Oceans, we may see the same thing on a scale so magnificent as to form a healthy and vigorous circulation for the whole world. In the great system of winds, of which the trade winds are the most constant, we have mighty currents of air which sweep from pole to pole, and are the very life of the earth over which they pursue their ceaseless course.

Thus the existence of the winds is due to sun-heat.[1]

Let us pause here for a moment to see what we have learnt. We have seen that the waves which beat on our shores, and denude our coast-lines, are due to the winds; that the rivers which cut down trenches into the earth are due to rain, which is itself brought to us as vapor of water by the winds; and we have seen that both the formation of water-vapor, and the existence of the winds, are due to sun-heat. This sun-heat is therefore the highest link we have yet reached in the chain of causation. We have also seen incidentally that the sand and clay at the top of the cliff were built up of mud and sand grains, carried down mechanically by rivers to the sea: and that the chalk has been separated by living creatures from the sea-water to which the lime had been carried down in solution by rivers. The question—how came this life upon the earth?—now arises. It will not however be discussed here. It is enough to state that it is almost universally believed by those competent to give an opinion, that all life forms have come into being by a process of evolution from primitive organic germs. It may be noticed, however, that all life, whether vegetable or animal, is made possible only by *solar energy*. Animals depend on plants, directly or indirectly, both for the food they eat and for the air they breathe. In the absence of sunlight plants would be unable to decompose the vast quantity of carbonic acid which animals breathe forth: and thus *their* source of carbon and our source of oxygen would be cut off.

Another question must now be put and shortly answered. The

[1] Their direction is modified by the rotation of the Earth.

sand and clay and chalk which form our cliff were laid down beneath the sea; how come they now to form dry land? Now it is clear that one of two things must have taken place: either the level of the sea has been depressed or the land has been raised. Geologists do not hesitate to say that it is the land which has undergone the change in level, while the sea has remained stationary. The sea is, in fact, more stable, more constant, more ancient than our oldest continents. All land is, on the other hand, subject to changes of level. In the Himalaya mountains shells, which once lived in the sea, are found at an elevation of 16,000 feet above the level of the ocean. The northern part of Scandinavia is even now slowly rising, while the southern portion is undergoing depression. But how? There lies the question.

It is now well known that the earth is, in the interior, in an intensely heated condition. In deep wells and mines the temperature rises about 1° Fah. for every sixty feet we descend. The melted lava poured forth during volcanic eruptions gives us some idea of the temperature comparatively near the surface. The centre of the earth must then be hot beyond conception. But it is gradually cooling. Heat is flowing outwards through the crust into space: the cooling of the earth is accompanied by contraction of the mass of the earth: and unequal contraction produces areas of depression and elevation.

Is this clear? Perhaps a comparison of great things with small will make it clearer. The human mind seems at times to fail to grasp facts which are, in truth, simple, but which from their magnitude are hard of conception. If, for instance, we stand on a high peak and look out over a portion of a great mountain chain, and see the grand summits standing out along the central ridge, it is difficult to conceive how this grand upheaval could have been produced; and perhaps the mind, wearied with the attempt to grapple with a subject almost too great for its powers, finds relief in the thought, that the mighty elevation was due to some great cataclysm or convulsion of nature, concerning the cause of which —as a matter beyond our ken—it would be rash to speculate. And if it were then suggested that mountain chains, such as that in the midst of which we were standing, must be the inevitable result of the contraction of a cooling globe, it may be that our understanding would reject a conclusion which it could not at once grasp.

But if when we have left the mountain top, we take up a withered apple of last year's growth, the consideration of its surface may help us to understand that which before was so hard to comprehend. When we plucked that apple, a year ago, its surface was smooth, and the skin was stretched tightly over the fruit beneath. But since that time the apple has shrunk in size, the fruit having contracted within the skin, which, no longer tight and glossy, is now wrinkled and puckered up.

But just as in the apple, so too in our planet, there is an inner portion which is contracting, and an outer portion which does not shrink: and as surely as the earth is losing heat by radiation into space, her mass contracting and her size growing less, so surely must the outer portion become puckered up, the most prominent wrinkles forming what we call mountain ranges.

While *sun-heat*, therefore, enables rain, rivers, and the sea to denude the land and to combine in the formation of new continents, *earth-heat* causes a fresh supply of land to be raised above the waters. Were it not for this earth-heat, England, as already, mentioned, would during the course of geological time be entirely washed into the ocean of geological bankruptcy. All geological action, except that due to the tides, is brought about by sun-heat or by earth-heat.

Before inquiring what is the cause of this sun-heat and this earth-heat, there is one more question to be answered. Of what does the air, the water, the cliff, ultimately consist? Are earth, air, and water, as the ancients believed, elements? No. The air is composed chiefly of a mixture of a gas called nitrogen with one-fifth of its volume of oxygen. It is not difficult, as will be seen in Professor Huxley's book, for the chemist in his laboratory to separate these two gases. Nor has he much difficulty in splitting up water into the two gases, oxygen and hydrogen; while the further task of ascertaining of what the solid crust of the earth is composed, though it requires more labor, is by no means beyond his powers. But whereas water contains but two elements, in the solid crust of the earth there are about sixty-five. But what are these elements? They are simple bodies which resist every effort of the chemist to decompose them into simpler bodies. Many chemists, however, believe that, though we cannot by any means at our disposal thus split them up, this is only because the means at our disposal are limited, and that, at an

intensely high temperature, all would be found to consist of one primitive form of elementary matter.

One of the most striking results of modern scientific inquiry is the discovery, by means of the spectroscope, that there exists in the sun's photosphere some sixteen or seventeen at least of the so-called elements, with which we are acquainted on the surface of our earth. Herein lies one of those many bonds, by which we are connected with our central luminary. The cause of these bonds; the origin of sun-heat and earth-heat; and of the sun and the earth themselves, now require elucidation.

According to the now-generally-accepted theory, known as the Nebular Hypothesis of Kant and Laplace (and it must be noted that we are here passing from the well known to the less known), our solar system was formed from a diffuse nebulous mass. We must imagine that this rotating spheroid mass once extended to the furthest limits of the solar system, beyond the orbit of Neptune. It radiated heat freely into space, and under the force of gravitation underwent contraction. And as it contracted it left behind it rings of vapor which, breaking up, formed secondary rotating spheroids, themselves contracting, themselves leaving behind them rings, forming tertiary spheroids, themselves passing in their orbits round the central mass. That central spheroid mass is the sun; one of the secondary rotating spheroids is the earth, the moon being a tertiary spheroid. The earth-planet thus formed was gaseous; but as time rolled on, it passed through the liquid state, to the more or less solid state, which it at present possesses.

Sun-heat is therefore the result of the condensation of the primary spheroid: earth-heat the remnant of that produced by the condensation of a secondary nebulous spheroid.

And now comes the question, how was the rotating nebulous spheroid formed?

If we take a small piece of lead and deal it a number of heavy blows with a hammer, we shall find that the lead becomes hot. If we continue to hammer for ten minutes, we shall find that the lead becomes too hot to hold. Now what is the cause of the heating of the lead. Simply this: when the lead is struck, the motion of the hammer is suddenly stopped; but the motion is taken up in a new form by the particles of the lead, and this new form of motion is heat. The visible motion of the hammer is converted into the invisible molecular motion of heat; for heat is simply the rapid vibration of the ultimate particles of matter.

When a bullet is shot from a rifle against an iron target, the rapidity of the motion is suddenly arrested; heat is developed; and this heat may in some cases be sufficient to melt the point of the bullet. In the same way the immense iron shot, hurled from our modern pieces of ordnance, cannot fail to be intensely heated, when they strike against the sides of such a ship as the *Inflexible*. It is quite conceivable that a shot or bullet of lead might be projected with such violence as to be, not only fused, but converted into vapor on striking the target. For when the motion of heat becomes extremely violent, the particles of matter are shaken asunder, and a vapor is formed.

We may take the velocity of a rifle bullet to be 225 feet in a second. The velocity at which the earth moves through space, as she travels round the sun, is about nineteen miles in a second. If we imagine that the earth were suddenly to strike a huge target, the heat generated would be sufficient, not only to fuse the earth, but to reduce it in great part to vapor. "The amount of heat thus developed would be equal to that derived from the combustion of fourteen globes of coal, each equal to the earth in magnitude. And if, after the stoppage of her motion, the earth should fall into the sun, as it assuredly would, the amount of heat generated by the blow would be equal to that developed by the combustion of 5600 worlds of solid carbon."

Now, it is supposed by Dr. Croll and others (and here, be it noticed, we pass to the still less known; to the purely hypothetical, but still conceivable), that the nebulous mass from which the solar system has been evolved resulted from the collision in space of two vast masses moving at great velocity. Each of these masses may be supposed to have developed from a nebulous mass, in the same way that the solar system has itself developed. Such nebulous masses were endowed with that high form of energy, which may be termed, generally, the energy of separation. But we have seen that this and all other intermediate forms of energy tend to run down, and be degraded to heat uniformly distributed throughout space. Some men of science tell us that this will be the ultimate condition of the energy of the universe. They tell us that the planets will fall into the sun, and that thus the matter of the solar system will be aggregated into one mass, that this mass coming into collision with another mass similarly formed will produce the nebulous spheroid from which another

system greater and grander than ours will be formed, and that so the same thing will go on until all the matter of the universe is aggregated into one mass, and all the energy of the universe is converted into uniformly diffused heat.

But here have transcended the powers of the human intellect. We have reached that thin atmosphere in which we can no longer build. We have traced the chain of causation as far as we are able. We have reached the Unknowable. When we seek to go further; when we inquire what is *matter*, what is *force*, what is the *ether* through which force acts on matter, what is the *space* in which co-existences are manifested, and the *time* in which sequences are manifested; when we inquire what is consciousness, what is the *thought* by which we are able to trace to some extent the chain of causation, we are met by alternative contradictories. We are in the presence of the Mystery of Mysteries. Let us humbly, modestly, truthfully confess our ignorance.

It may, perhaps, be said that there is much in the foregoing pages that is quite out of place in the *Geological Magazine*—much about wind and aqueous vapors, the Nebular Hypothesis and the Unknowable. But is it out of place? If there be any truth in my opening paragraph—that just as an artist has now and again to view his picture from a distance, so does the man of science have from time to time to take a comprehensive survey of his subject—No. In any consideration, however imperfect, of the work which Geology is doing for Modern Philosophy, we must weave that work into the general picture presented by the study of Nature. This I have attempted to do. In the place I have endeavored to point out the law of causation; that all that we see about us has been *caused* in some way or other. In most cases, from the nature of the subject, this law of causation has been illustrated qualitatively; but in the case of the formation of water-vapor the quantitative truth of the law has been indicated; and the law of the conservation of energy briefly alluded to. In the second place I have tried to show, as far as was possible in the space at my command, how the crust of the Earth has been built up by the mechanical agency of rivers, forming deltas, and the vital agency of simply-constituted creatures. By these two agencies nearly all the rocks have been formed, with the exception of salt, and, perhaps, magnesian limestone, which are due to chemical agency. By the action of earth-heat and other causes, however,

some of these rocks have been so altered that their original source is scarcely, if at all recognizable. How this earth-heat has raised the strata, thus formed beneath the sea, above the waters of the ocean, has been pointed out; and the action of the sea-waves, and of rain and rivers in carving out the face of the country, horizontally and vertically, has been indicated. In tracing the chain of causation from the well-known to the Unknowable, I have not followed the example set by Prof. Huxley in the excellent little book which bears the same title as this article. In these days, however, when we hear so much of the "pride of Science," it is well to point out that in the study of Nature we reach at last ultimate questions, with respect to which we must one and all confess with modest humility that we are and must be ignorant. Finally, in making each fact the effect of one which had gone before it, in time, and the cause of one which followed, I have aimed at that *organization* of knowledge, without which any number of accumulated facts are but isolated pieces of general information.—*Geological Magazine.*

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RECENT LITERATURE.

BREHM'S ANIMAL LIFE.[1]—The third volume of this interesting series, which is to comprise in all ten large octavo volumes, is at hand, and perhaps the present one is as valuable and entertaining as any, since it treats of the horses and Ruminants, and the seals and Cetacea. There are one hundred and twenty wood-cuts of the same general excellence as those which appear in this notice, and there are besides twenty-one full-page plates; those of the Shetland pony, zebra, ibex, jak, stag, bison, rhinoceros, wild boar and sea lions being especially attractive, and apparently faithful studies by the most eminent German zoölogical artists. Among the wood-cuts the antelopes, elands, spring-bock, hartebeest and their allies, are well rendered. The figures that we have selected are fair examples of the artistic work. The American reader will find that some of the characteristic ruminants of his country are well drawn, as in the Rocky Mountain sheep (Fig. 1), and the musk ox (Fig. 2). The hippopotamus is well drawn, especially its head and face, and its skeleton (Fig. 3.) is represented, while the account of it by Dr. Brehm is detailed and fresh. The

[1] *Brehm's Thierleben.* Allegemeine Kunde des Thierreichs. Grosse Ausgabe. Zweite umgearbeitete und vermehrte Auflage. Erste Abtheilung. Säugethiere. Dritter Band. Leipzig, 1877, 8vo. For sale by B. Westerman & Co., New York, at 40 cents a part.

excellent drawing of the walrus is too large for us to reproduce in these pages, but as a skeleton has lately been exhumed at Portland, Maine, and skulls have occurred as far south as Virginia, and are likely to occur at other points, we have, by permission of the publishers inserted a figure of the skeleton (Fig. 4).

The chapter on the *Sirenia* is full and entertaing, the dugong of the East Indian seas (Fig. 5.) is apparently well drawn, as is

FIG. 1.—The Rocky Mountain Sheep.

the lamantin or manatee of South America. While the account of the latter animal is fair, the northern limits of its distribution in Florida is not given, nor are the statements of American authors referred to. Steller's manatee (*Rhytina Stelleri*) is described in a popular way, but the opportunity of giving a good figure of this extinct Sirenian, if that were possible, is not taken. The Cetaceans receive fair treatment, and there are several good illustrations of them.

FIG. 2.—The Musk Ox.

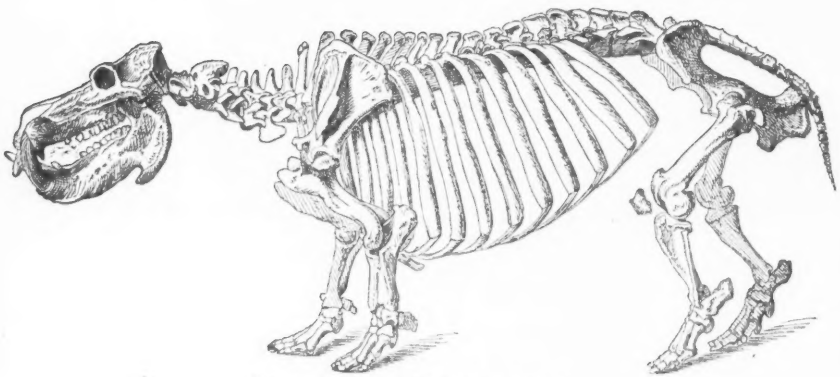

FIG. 3.—Skeleton of the Hippopotamus.

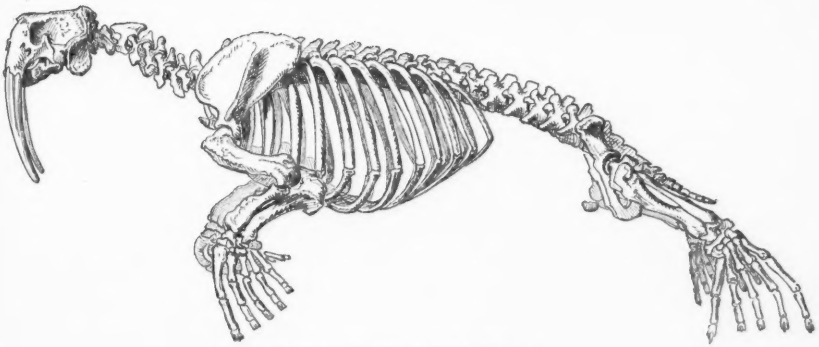

FIG. 4.—Skeleton of the Walrus.

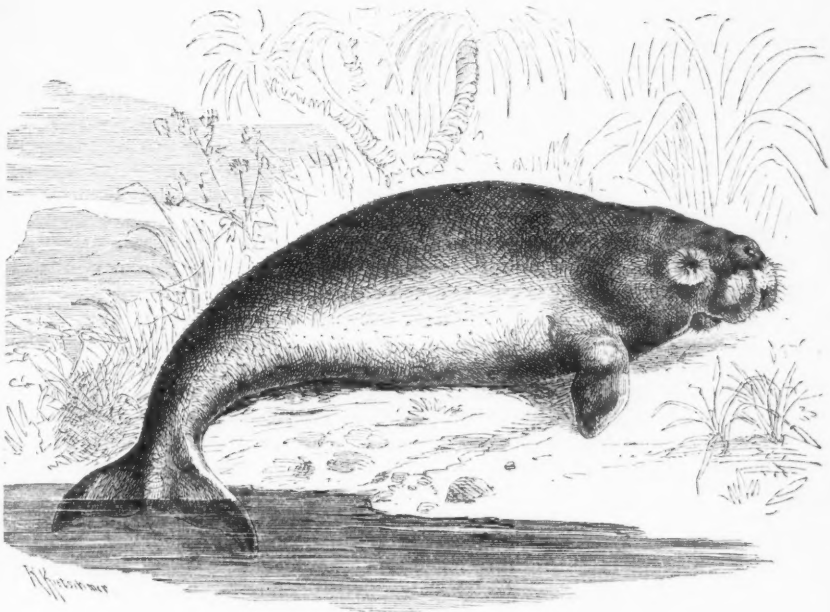

FIG. 5.—The Dugong.

This work has been very highly commended by Darwin, Haeckel, Leuckart and others, and it is the most authoritative popular illustrated work of the kind.

GRAY'S FLORA OF NORTH AMERICA.[1]—All botanists will accept with sincere thankfulness this beginning of the new "Flora." A beginning at the middle, indeed, yet not a "beginning of the end;" but so that the work be done the order of its doing may well be left to his choice who is looked upon with one accord as the only one competent for its proper performance. If a preference might be expressed in regard to it, it would doubtless be that Dr. Gray would see fit to give next a revision of what is by far the most intricate and difficult of all the orders of our flora, viz: the *Compositæ*. No portion of the proposed volumes is more needed by botanists or will be more acceptable, and in none is Dr. Gray more truly the sole authority. As he has recently gone over a considerable portion of the ground in his work for the "Botany of California," this would be all the easier for him.

In looking over the present issue, some peculiarities of arrangement at once attract attention. There are no artificial keys either to genera or species. Under each order the ordinal character is followed by a synopsis of the genera, with concise but essentially complete characters, grouped together not only by sub-orders or tribes (where such exist), but also by minor subdivisions, and under characteristic headings, thus avoiding repetition, and leading most directly to the genus sought. When the genus itself is taken up, only such other details, general remarks and synonymy are given as may be needed to fully supplement the previous description. A comparison with the published volumes of "Torrey and Gray's Flora" will make the improvement of plan manifest, and show the appropriateness of the title which Dr. Gray has adopted. The same synoptical method, however, is not carried out in the treatment of species, though they are similarly grouped under common headings so far as they have essential characters in common. The specific descriptions themselves are full, but without redundancy or needless repetition. Of their technical accuracy and finish it is unnecessary to speak. It may perhaps be questioned whether it would not have been well, at least in the larger genera, to have subjected the species to the same process as the genera themselves. One would imagine that what is best in the one case should be best in the other also. Experience in the use of the book should determine. As compared with the "Manual" the descriptions are much fuller, and yet, even with the additional synonyms, etc., the species occupy on the average but little more space. A synoptical key to the orders has been omitted, doubtless because it will come more properly in the first volume at the beginning of the *Gamopetalæ*, of which we have here only the concluding portion.

[1] *Synoptical Flora of North America.* By ASA GRAY, LL.D., F.M.R.S. and L.S. Lond., R.I.A., Roy. Soc. Upsala, Stockholm, Göttingen; Roy. Acad. Sci. Munich, Berlin, etc.; Corresp. Imp. Acad. Sci. St. Petersburg, etc.; Fisher Professor of Natural History (Botany) in Harvard University. Vol. ii, Part i. Gamopetalæ after Compositæ. New York, Ivison, Blakeman, Taylor & Co. London, Trübner & Co., Ludgate Hill. Leipsic, T. O. Weigel. May, 1878.

Much care has evidently been taken in the selection of the type used for different purposes, and in the general "get up" of the book. It is a satisfaction to see that Dr. Gray has not countenanced, in the writing of botanical names, the methods of punctuation and the disuse of capital letters so generally favored by American zoölogists and entomologists, and which some would force upon our botanists. Whatever may be the rules of punctuation in Latin or in the Continental languages, in the use of the English language the same principles should apply in writing upon botany as upon other subjects. In general, thus far, this has been the case. English-writing botanists, and most English Latin-writing botanists, as well, have been united in their adhesion to English customs in this matter, and it is to be hoped that they will so remain.

The portion of the gamopetalous flora here described includes 1560 native species, belonging to 298 genera. The introduced plants add twenty-six genera and ninety-six species. A comparison with the number of species native to the region covered by the "Manual" (as given in the second edition) makes the probable entire number of phenogamous species in North America to lie between nine and ten thousand. The same conclusion is deduced from the number of polypetalous species as enumerated in the "Bibliographical Index." The mean result from the two comparisons is 9,378 species, so that 10,000 is very probably a closely approximate limit. Of the 298 genera, 120 have only a single species each. By far the most important order is that of the *Scrophulariaceæ*, containing 38 genera and 315 species, the next in order being the *Labiatæ*, with 37 genera, but only 189 species. These orders, with the *Ericaceæ*, *Borraginaceæ*, *Hydrophyllaceæ* and *Polemoniaceæ*, include nearly half of the genera and over three-fifths of the species. The largest genera are *Pentstemon* with 71, *Gilia* with 70, and *Phacelia* with 56 species.

As regards the distribution of this flora, it appears from a very cursory examination that it divides readily into an eastern, a central and a western section. The first may be considered as covered essentially by Gray's Manual and Chapman's Flora, and the last in good degree by the Botany of California. Taking these as a guide, and making to each the additions indicated by the present "Flora," it is found that the eastern division includes 610 native species, of which 130 are peculiar to the Manual, 205 to Chapman's Flora, and 275 common to both. The Botany of California includes 567 species, of which 58 belong also to the Atlantic States. Of the remaining 450 species, 48 are high northern and do not enter the United States, 8 are Mexican and not yet found within our limits, 290 are mainly southern, belonging to the warmer and dryer interior, and 103 are found only in the Rocky Mountains or the cooler region westward to Oregon. Had Greenland been included in the limits adopted by Dr. Gray,

only two other species (*Veronica fruticulosa* and *Gentiana nivalis*) would have been added, and of these the latter is reported from Labrador.

Numerous additions and changes of nomenclature are made in the several sectional floras above mentioned—some of them new, many to be found in previous publications. About 40 species are added to the flora of the southern Atlantic States, chiefly from Florida, and nearly 50 species to the flora of California. The changes to be noted in the flora of the Northern States as given in Gray's Manual (edition of 1868) are less numerous, but some of them are of moment. The following list includes all of the more important:

Phyllodoce taxifolia is referred, with the other species of the genus, to *Bryanthus*—becoming *B. taxifolius*, Gray.

The species of *Azalea* are referred to *Rhododendron*, as was done by Dr. Torrey over fifty years ago, to whom the species are credited. *Rhodora Canadensis* also becomes *Rhododendron Rhodora* of Gmelin (Syst. i. 694, 1796), instead of Don as stated.

The order *Aquifoliaceæ* is excluded as belonging rather to the polypetalous division. This is likewise the case with the closely allied southern order *Cyrilleæ*.

The name *Plantago Rugelii*, Decaisne, is restored for the plant which is referred in the Manual to *P. Kamtschatica*. *P. decipiens*, Barneoud, is also substituted for *P. maritima*, var. *juncoides*, which latter species is not found in the Atlantic States.

The genus *Steironema*, Raf., is restored for the section of that name under *Lysimachia*.

Utricularia striata, LeConte, is referred to *U. fibrosa*, Walter. The questionable species mentioned in the Manual at the end of the genus is made Var. *cleistogama* of *U. subulata*.

Phelipæa Ludovciana becomes *Aphyllon Ludovicianum*, Gray.

Chelone obliqua, Linn., is added—a bright rose-colored species, ranging from Illinois and Virginia to Florida.

Pentstemon digitalis becomes *P. lævigatus*, Solander.

Gerardia integrifolia, Gray, is *G. lævigata*, Raf., and *G. setacea* (not Walt.) is *G. Skinneriana*, Wood.

Bartsia Odontites, Huds., is added as sparingly naturalized on our northern coast.

The varieties of *Lycopus Europæus* are established as species, viz: *L. sessilifolius*, Gray, *L. rubellus*, Moench, and *L. sinuatus*, Ell.

Pycnanthemum pilosum is made a variety of *P. muticum*.

Calamintha Nuttallii, Benth., is restored.

Monarda clinopodia, Linn., is added, intermediate between *M. didyma* and *M. fistulosa;* also *Physostegia intermedia*, Gray, of Western Kentucky and south-westward.

Stachys aspera, Michx., and *S. cordata*, Riddell, are restored for varieties of *S. palustris*, the var. *glabra* being referred to the former.

Onosmodium molle is made a variety of *O. Carolinianum.*

Lithospermum longiflorum is referred to *L. angustifolium.*

Myosotis palustris, var. *laxa*, becomes *M. laxa*, Lehm.

Cynoglossum Morisoni is transferred to *Echinospermum* as *E. Virginicum*, Lehm.

Heliotropium tenellum, Torr., is to be added as found in Kentucky.

Ellisia ambigua is reduced to a form of *E. Nyctelea.*

Phlox ovata, Linn., is restored for the broad-leaved form of *P. Carolina*, while var. *nitida* is referred to *P. glaberrima*, var. *suffruticosa*, Gray. *P. amœna*, Sims, is substituted for *P. procumbens* (not Lehm.), and *P. Stellaria*, Gray, is added.

Diapensia and *Pyxidanthera* are united with *Galax* and the southern genus *Shortia* to form the order *Diapensiaceæ.*

Calystegia is returned to *Convolvulus*, where our species were originally placed by Linnæus.

The species referred in the Manual to *Bonamia* are transferred (following Benth. & Hook.) to *Breweria*, R. Br., as distinguished from *Bonamia*, Thouars, by the plicate corolla. It is perhaps through oversight that the species are not credited to Benth. & Hook., who refer to the Manual for the three known North American species.

The perennial forms of *Physalis* are referred to *P. Virginica*, Mill., instead of to *P. viscosa*, Linn., and to *P. lanceolata*, Michx., in place of *P. Pennsylvanica*, Linn.

Gentiana detonsa becomes *G. serrata*, Gunner, and var. *linearis* of *G. Saponaria* is kept distinct as *G. linearis*, Fries. The recent discovery of *G. amarella*, var. *acuta*, in Vermont should be noted.

Forsteronia differmis is transferred, with some doubt, to *Trachelospermum*, Lemaire, a genus of Eastern Asia.

Acerates paniculata is referred to *Asclepiodora*, a genus proposed by Dr. Gray for all the later species of *Anantherix*, Nutt., which is restricted to the single species upon which it was founded.

Ligustrum vulgare is inadvertently omitted.

Olea Americana is separated from *Olea*, Tourn., by Benth. and Hook., and carried to the Chinese genus *Osmanthus*, Lour.—*Sereno Watson.*

GRABER'S INSECTS.[1]—The author of this work is Professor of Zoölogy, at the University of Czernowitz, Austria, and is well and most favorably known by his beautiful and elaborate histological researches on the organs of hearing in insects, and other points in their minute anatomy, especially of the digestive canal of orthoptera, &c. The popular work on insects is a comprehensive and original treatise on their anatomy, general and minute, physiology and biology. The illustrations are new and

[1] *Die Naturkräfte.* Eine naturwissenschaftliche Volksbibliothek, xxi, xxii, Band. Hälfte i. Die Insekten, Von DR. VITUS GRABER. München, 1877, 12 mo. pp. 403, 261.

original, and those representing the anatomy and histology of insects are new and valuable. Especial attention is devoted to the mechanics of the appendages as well as the trunk and wings. The nervous system is thoroughly discussed, while the structure and functions of the organs of sight, hearing, touch, smell and taste are treated of at length. The portion on reproduction is not so original as the rest of the book. The second part is devoted to the habits of insects, and is more of a compilation than the first part, the author's *forte* being the anatomy and physiology of insects, his skill in anatomical drawing being of a high order. The work forms the twenty-first and twenty-second volumes of a series of popular works on *Naturkräfte*, a word not easily translated, but the series corresponds to the international science series of the Appletons. The illustrations are excellent and numerous, being a most valuable feature of the work.

RECENT BOOKS AND PAMPHLETS.—Freie Wissenschaft und freie Lehre. Eine Entgegnung auf Rudolf Virchow's Münchener Rede über "Die Freiheit der Wissenschaft im modernen Staat." Von Ernst Haeckel. 8vo, pp. 106. Stuttgart, 1878. From the author.

Notice sur l'Habitat et les Caractères du Macroscincus coctei (Euprepes coctei, Dum. et Bibr.) Par J. V. Barboza du Bocage. 8vo, pp. 12, with photographic plate. Lisbon, 1873. From the author.

Mélange Erpetologiques. Par J. V. Barboza du Bocage. (Ext. do Jorn. de Sci. Math. Phys. e Naturales, Lisboa, 1873.) 8vo, pp. 24. From the author.

Lista de Mammiferos das possessoes portuguezas da Africa occidental e diagnoses de algumas especias novas. Pelo Dr. W. Peters, Director Mus. Zoöl. da Univ. Real de Berlin. (Ext. do Jorn. etc.) 8vo, pp. 5. Lisbon, 1870. From the editor.

Algumas consideraçoes ácerca da industria piscicola em Portugal. Por F. de Brito Capello. (Ext. do Jorn. etc.) 8vo, pp. 9. Lisbon, 1870. From the author.

Entomological Notes vi. By Samuel H. Scudder. (Repr. Bost. Soc. Nat. Hist., Vol. xix, 1877–78) 8vo, pp. 55. Boston, 1878. From the author.

Additions to the Insect-fauna of the Tertiary Beds at Quesnel (British Columbia). By Samuel H. Scudder. (Ext. Geolog. Surv. Canada. Rep't of Progress, 1876–77.) 8vo, pp. 8. From the author.

Psyche. Organ of the Cambridge Entomological Club. Vol. ii, Nos. 45, 46, Cambridge, Mass., Jan., Feb., 1878. 8vo, pp. 97–120. From S. H. Scudder.

Proceedings of the American Association for the Advancement of Science. Twenty-sixth Meeting, held at Nashville, Tenn., Aug., 1877. 8vo, pp. 400. Salem, 1878.

Journal of the Franklin Institute. (Third series, Vol. lxxvi, N o. 2, Aug., 1878.) From the Institute.

Die Reptilien und Fische der Böhmischen Kreideformation. Von Dr. Anton Fritsch. Mit 10 lithographischen Tafeln und 66 Holzschnitten. 4to, pp. 44. Prag, 1878. From the author.

The Journal of the Royal Geographical Society. Vol. xlvii for 1877. 8vo, pp. i–iv, 300, with 14 maps and plates. London, John Murray, 1878. From the Society.

Labyrinthodon Rütimeyeri. Ein Beitrag zur Anatomie vom Gesammt Skelet und Gehirn der Triassischen Labyrinthodonten. Von Robt. Wiedersheim, Prof. in Freiburg i. B. (Abhand. d. Schweiz. Paläont. Gesellsch. Vol v.) 4to, pp. 56, plates 3. Zürich, July, 1878. From the author.

Proceedings of the California Academy of Sciences. Vol. vi, 1875. 8vo, pp. 222, and Vol. vii, part i, 1876, 8vo, pp. 176. San Francisco, 1876–7. From the Society.

Annual Record of Science and Industry for 1877. Edited by S. F. Baird, with the assistance of eminent men of science. 8vo, pp. 480. New York, Harper & Brothers, 1878.

First Annual Report of the United States Entomological Commission for the year 1877, relating to the Rocky Mountain Locust and the best method of preventing its injuries and of guarding against its invasions; in pursuance of an appropriation made by Congress for this purpose. With maps and illustrations. 8vo, pp. 477, and appendices 294. Washington, 1878. From the Department of the Interior.

Zoölogischer Anzeiger. Herausgegeben von Prof. J. Victor Carus in Leipzig. I Jahrgang. Nos. 1–3. July, 1878. 8vo, pp. 60. Verlag von Wilh. Engelmann, Leipzig. Jährlich erscheinen 25–26 Bogen. Price 6 marks. From the editor.

Tidskrift for Populære Fremstillinger af Naturvidenskaben, udgivet af C. Fogh, C. F. Lütken og Eug. Warming. Femte Raekke, Femte Binds, Tredje Aargang. 8vo, pp. 161–240. Kjöbenhaven, 1878. From the editors.

The Botanical Gazette, August, Sept., 1878, Vol. iii, No. 3. 8vo, pp. 65–72. J. M. & M. S. Coulter, Editors and Publishers, Logansport, Ind., 1878.

The American Journal of Microscopy and Popular Science. Vol. iii, No. 7, New York, July, 1878. From the editor.

Proceedings of the Royal Geographical Society, Vol. xxii, Nos. 2, 3, March and May, 1878. 8vo, pp. 67–229. London. From the Society.

Matériaux pour l'Histoire Primitive et Naturelle de L'Homme. Revue Mensuelle Illustrée dirigée par M. Emile Cartailliac avec le concours de MM. P. Cazalis, Fondouce et Chantre. 2e Serie, Tome ix, 1878. 4e et 5e livraisons with map. 8vo, pp. 147–248. Toulouse, 1878. From the editors.

The Popular Science Monthly, August, 1878, No. lxxvii. Supplements xv, xvi, July and August, 1878, 8vo. New York, D. Appleton & Co. From the editors.

Le Naturaliste Canadien. Redacteur, M. L'Abbe Provancher. Vol. x, No. 6, June, 1878. Cap Rouge, Prov. de Quebec, Canada. From the editor.

Proceedings of the Academy of Nat. Sciences of Phila., 1878. 8vo, pp. 217–264. From the Society.

La Tempestad de los Dias 7 y 8 Abril de 1878. Estudia Meteorologico por el ingeniere civil Vicente Reyes. 8vo, pp. 12 and chart. Mexico, 1878. From the author.

Addenda to etiological views expressed in a paper "On the mechanical genesis of tooth-forms." By J. A. Ryder. 8vo, pp. 3. (Dental Cosmos, Repr.) September, 1878. From the author.

The Bee-keepers' Magazine. Vol. vi, No. 8, August. 8vo, pp. 154–176. New York, A. J. King & Co., 1878.

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GENERAL NOTES.

BOTANY.

The Grasses of Mexico.—M. Eugéne Fournier has raised the number of species of grasses from eighty-eight, as reported in Kunth's Synopsis, to 638. He finds that sixteen species extend from the shores of the ocean to the elevated plateaux. He also finds, as he had previously done in regard to the ferns, that many species grow on both slopes of the Cordilleras. Out of 162 species common to Mexico and other regions, only two grow in California. East of the Rocky Mountains, Texas has thirty-two species, one grows in the prairie region, and the other fifty-nine United States species are almost confined to Florida, Georgia and South Carolina, scarcely any occurring in Louisiana, Mississippi, or Alabama. The cause of this peculiar distribution may be found in the direction of certain winds, especially the whirlwinds

noticed by M. F. F. Hebert, which, descending upon the Gulf of Mexico by the valley of the Rio del Norte, strike the north of Florida, and then sweep northward along the eastern slope of the Alleghanies.

By their geographical distribution and botanical characters, the Mexican *Gramineæ* are divided very clearly into two groups—those which are peculiar to Mexico or common to it, and the Andean region, or to more northern regions, are generally distinguished by the slenderness and lightness of their leaves and panicles; those which spread into the tropical region, on the contrary, are remarkable by their size, and the amplitude of their organs of vegetation and of their inflorescence. The former generally inhabit dry and mountainous localities; the latter the banks of rivers, and moist places; some of them extend from the United States to the Argentine Republic through 70° of latitude (*Comptes rendus* June 10, 1878)

The Connection of Bacilli with Splenic Fever.—Doubt having been thrown on the supposed fact that splenic fever is caused by *Bacillus anthracis*, Dr. Ewart has published in the Journal of Microscopical Science, the result of his studies. In the spleen of a mouse which had just died of the disease after being inoculated with the plant, the *Bacilli* were found rod-shaped and motionless. In a few hours, the temperature being 30° C. (= 91° F.), many of these rods began to move actively in a wriggling manner, and after continuing in this motile state for some time, they either suddenly or gradually settled down again, and then lengthened out into spore-bearing filaments. A mouse inoculated with the spores thus obtained, died in forty-eight hours of splenic fever. The spores are formed in a similar manner to the Chlamydospores of *Mucor*.

By Koch and some other observers, these spores have been described as germinating at once, and reproducing the rods, but Dr. Ewart found that this process was often preceded by the division of the spore into four sporules, all of which closely adhere at first, but ultimately become free and settle down in colonies. The sporules then germinate and produce the rods. The most important morphological conclusion which Dr. Ewart draws from these other observations is that the *Micrococcus*, *Bacterium* and *Bacillus* forms, and the spore-bearing hyphæ are phases of the same life history. His experiments have been confirmed by other observers.

Ascent of Sap in Trees.—A theory has lately been propounded, and thoroughly worked out by Joseph Böhm, which is said by a writer in *Der Naturforscher*, according to *Nature*, to be characterized by good consistency, and offers perhaps a more satisfactory explanation of the phenomenon than any that have been referred to. It is based, like the osmotic theory, on the cellular structure

of all sap-conducting plants, and it attributes an important *rôle* to the *elasticity of the cells.* "When the surface-cells of a plant," says M. Böhm, "have lost a portion of their water through evaporation, they are somewhat compressed by the air-pressure. Like elastic bladders, however, they tend to take their original form. This of course is only possible by their drawing in either air or water from without. Since, however, moist membranes are little penetrable by air, the cells draw from cells farther in a portion of their liquid contents. These again borrow from their neighbors further down, which contain more water, and so on, either to the extreme root-cells or to those parts of the stem which are supplied with water from below through root-pressure."

To illustrate the action, M. Böhm constructed an artificial cell-chain. A funnel closed by a bladder represented the evaporating leaf; to it were connected below several glass tubes about two ctm. wide, closed at one end with a bladder, and joined together in series by means of thick walled caoutchouc tubing. In consequence of the evaporation, the membrane which closes the funnel mouth is bent inwards, and when it has reached a certain tension, water is sucked into the funnel out of the next lower cell, which covers its loss in like manner. Manometers, connected with certain cells of the apparatus, indicate the amount of suction at different heights. To avoid fouling of the membranes, carbolic acid was mixed with the distilled water in the cells. Since bladder membranes, with a not very great height of liquid column over them, admit passage of water by filtration, these artificial cell-chains (it is pointed out), must act much more imperfectly than the sap-conducting cells placed over one another in living plants, which cells, by reason of their narrow aperture, retain their liquid column by capillary attraction.

It is shown that this theory is in harmony with sundry phenomena which are contradictory of the imbibition theory.

Austin's Musci Appalachiani.—Supplement I to *Musci exsiccatæ*, containing one hundred tickets of specimens of mosses collected mostly in the eastern part of North America, by Col. F. Austin, will interest botanists. The author proposes to publish additional supplements to both the *Musci* and *Hepaticæ* which have been issued, to comprise one hundred sets of from ten to fifty specimens each. The specimen illustrating the first supplement are to be had for $6 a set.

Botanical News.—Trimen's *Journal of Botany* for July contains a paper on the structure and affinities of *Characeæ*, by A. W. Bennett. A summary is given of Dr. Kienitz-Gerloff's exhaustive study of the development of the capsule of *Phascum cuspidatum.* The *Botanischer Zeitung* contains papers by H. Hoffmann on experiments in culture, and by J. Sachs "on the history of the mechanical theory of growth of organic cells."—The *Annales des*

Sciences Naturelles contains articles by A. Guillaud on the comparative anatomy and development of the stem in Monocotyledons, and by E. Warming on the ovule, and by Van Tieghem on the *Mucorineæ* (third paper).

ZOÖLOGY.[1]

TWO-HEADED SNAKES.—In reference to the two-headed snakes mentioned on pages 264 and 470 of the NATURALIST of the present year, I would say that there exists another specimen without locality in the collection of the Lyceum of Natural History of Williams College. In the same collection is a specimen of a five-legged frog (*Rana sp.*) from Rochester, N. Y. In this the fifth leg is situated between the two posterior pairs and just above the anus, and is in all respects as perfect as the two normal ones. The specimen is about as large as the average *R. palustris*, and, if I remember rightly, belongs to that species.

In "An Essay on the Natural History of Guiana," London, T. Becket and P. A. DeHondt, 1769, the author discourses upon the *Amphisbænæ* of that country, stating that they have a head at each extremity, and "yet, except these there is no animal in nature that is thought to have two heads;" and in a foot note on the same page (214) says: "I have received a particular description of a monstrous *Amphisbæna* found near Lake Champlain in North America by an officer in the American service, who, with one of his Majesty's draughtsmen, was sent during the late war to make a survey of that lake. They were previously informed by the Indians of the existence of these serpents, one of which they killed near a bay in Lake Champlain, which in the maps of that country has been since called Double-headed-snake bay. This serpent was a small one of the kind, it being about fifteen inches in length and largest near the middle, terminating in a slender tail. The body at the other end divided into two necks of equal size, to each of which was joined a perfect head, with two eyes, a large mouth and throat, a forked tongue, with teeth of the same species with those of the rattlesnake. The color of the heads was dark brown, and the scales on the back and side were variegated of dark and reddish-brown colors, in magnitude and disposition resembling those of the rattlesnake. This serpent was a perfect monster, of whose existence I should strongly doubt, did I not think the veracity of the gentlemen from whom I have this information, and by whom it was unquestionably killed, unquestionable."

The frontispiece of the same volume gives a figure of this same specimen, drawn by M. Park, and bearing the inscription "*Amphisbæna* or double-headed snake. This snake was found near

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

Lake Champlain, in America, in the year 1761, by Lieut. Moses Park."

The figure has a lighter U-shaped mark upon the heads, and a dorsal row of rectangular spots alternating with a similar lateral row on each side, reminding one strongly of the arrangement of the squares on a checker board.—*J. S. Kingsley.*

Mimetic Coloring in Tadpoles.—Recently I came across a very pretty instance of imitative coloration in some tadpoles caught in a weedy pool in Cold Spring, New York. The largest tadpoles are an inch and three-quarters long, bodies half an inch long, and widest part of tail half an inch. The hind legs are visible, but very small. They are greenish above with black markings, and have minute golden spots about the eyes and along the sides; beneath they are silvery white. Their tails are orange-red for more than two-thirds the length, and the color deepens toward the end and along the margin. There are black spots and irregular lines, which are very distinct, on the margin. The largest tadpoles are more brightly and distinctly colored.

In the same pool there is a plant (*Ludovidgia palustris*), whose lower leaves, which are under water, are *exactly* the same color as the tails of the tadpoles. The brightest ones are generally full of holes. The tails of the tadpoles also resemble the leaves in width and shape. The resemblance of color is so striking that a friend, who is not on the lookout for analogies, pointed out a leaf as a tadpole in the vessel where they both were placed. Some that I have had in a soup plate for several days have become very much paler, both the green and red, and the spots are almost invisible. These tadpoles show how early Batrachia begin to adapt themselves to their color-surroundings.—*Sarah P. Monks.*

Fresh-water Mussels vs. Ducks.—In the Naturalist for July I notice a communication from Mr. R. Ellsworth Call, in which he mentions that he has been informed that Mr. A. F. Gray has the foot of a water-fowl to which is attached a bivalve shell. Several years ago while shad-hatching for the United States Fish Commission, on the Pamunky river, near White-house landing, Va., I noticed great quantities of Unios, and in remarking on it to a gentleman residing there, was informed that it was not possible to raise ducks in that locality on their account, for at low water the ducklings were liable to be caught by the mussels and held until drowned by the rising tide.

This story was afterward confirmed by the Pamunky Indians, who live on an island below White-house, and who, with every facility for raising large quantities of ducks, do not keep them.—*Fred. Mather, Newark, N. J.*

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—The American Association for the Advancement of Science, meeting this year in the very heart of our antiquarian region, was favored with many valuable papers. The character of these communications is improving from year to year, and less of wild speculation characterizes the discussions. To facilitate interchange among students, we append a list of papers with the addresses of the authors:

Ancient Mounds in the vicinity of Naples, Scott county, Illinois, J. G. Henderson, Winchester, Ill.; Ancient Names, Geographical, Tribal and Personal, in the Mississippi valley, same author; Description of two Stone Cists, discovered near Highlands, Ill., by Arthur Oehler, of Highlands, Ill.; Description of a Cliff-house in the cañon of Mancos river, Colorado, Wm. F. Morgan, Rochester, N. Y.; Remarks on the Ruins of a Stone Puĕblo on the Animas river, New Mexico, with a ground plan, Lewis H. Morgan, Rochester, N. Y.; Observations on the San Juan River district as an important ancient seat of Village Indian Life, same author; On the Sources for Aboriginal History of Spanish America, by A. F. Bandelier, of Highland, Ill.; Remarks on the Archæology of Vermont, by G. H. Perkins, of Burlington, Vt.; Remarkable Burial Custom from a Mound in Florida; The Cranium utilized as a Cinerary Urn, Henry Gillman of Detroit, Mich.; Description of a Glazed Earthen Vessel, taken from a Tumulus in Florida, same author; Evidence of Cannibalism in a Nation before the Ainos in Japan, by E. S. Morse, of Japan; An Atlas of North American Antiquities, by O. T. Mason, of Washington, D. C.; North American Indian Synonomy, same author; Ancient Pottery from Chiriqui, Central America, by O. C. Marsh, of New Haven, Connecticut; On the Anatomical Peculiarities by which Mound-builders' Crania may be distinguished from those of the Modern Indian, by W. J. McGee, of Farley, Iowa; Exhibition of Pre-historic relics from Missouri, by A. J. Conant, of St. Louis; An Account of an Exploration of a Walled Town of the Mound-builders of the Cumberland valley, by F. W. Putnam, of Cambridge, Mass.; On the Discovery of a Human Skull in the Drift near Denver, Colorado, by Thomas Belt, London, England. We can but feel that the American Association is the proper meeting for our American anthropologists to patronize, not to the disparagement of local and State societies, but as a supplementary means of better acquaintance among workers in all parts of our country.

The May number of the *Journal* of the Anthropological Institute contains the following papers: On Flint Implements from Egypt; Discoveries at Cissbury; Collection of Andamanese and Nicobarese objects; The Ethnology of Motu; Palæolithic Im-

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

plements in the Valley of the Axe; Notes on the Zaparos, and the President's Address. Especial interest attaches to the detachable spear-heads, or harpoon-heads on plates xii, xiii, xiv, xv, as well as to the many-pronged fish or bird-spears, because these objects resemble so closely those found in various parts of America. Referring the matter to Mr. Frank H. Cushing, of the National Museum, we received the following reply: "Three kinds of harpoon-arrows are found among our North American collections. A very rude form is used by the McCloud River Indians in catching salmon. Another entirely typical, highly finished, and as often pointed with native copper as with bone or ivory, is employed by the North-west Coast Indians for the same purpose. A third common to the Alaska Eskimo, and entirely resembling the formidable fishing spears of the Andaman Islanders." Without drawings it is impossible to convey the resemblance between the loose headed implements of Andaman and Nicobar and those of our American continent.

The Smithsonian Institution has lately published through the Government Printing Office four pamphlets relating to archæological subjects. They are reprints from the forthcóming Smithsonian Report for 1877. We can only give the titles: Aboriginal Structures in Georgia, by Charles C. Jones, Jr.; On a Polychrome Bead from Florida, by S. S. Haldeman; The Stock-in-trade of an Aboriginal Lapidary, by Charles Rau; Observations on a Gold Ornament from a Mound in Florida, by the same.

A writer in the *Nation* for July 25th gives a very graphic description of the lessons of the Bannock war. A scientific journal cannot discuss the merits of the amount of culpability resting on our government for the war. A very interesting illustration of the aid which ethnology may furnish to politics is given in a supplementary note on page 57, evidently from the same pen. "The word Bannock is a corruption for Pannaiti [Panaiti?] by which name the people know themselves, and means 'Northerners,' they, in fact, dwelling the furthest north of all the tribes composing a great linguistic stock which once occupied nearly the whole of the interior basin between the Rocky Mountains and the Sierra Nevada, and crossed over both those ranges at several points in the south of California, reaching the Pacific. A large part of the whole family has in the past been styled 'Shoshoni' or 'Snakes,' after one of its prominent divisions. The Bannocks and Paviotsos are hereditary enemies. The Umatillas, Cayuse, and Walla-Wallas are of the Sahaptin family, whose immemorial feud with the Shoshones would induce them to attack rather than to join the Bannocks."

Prof. De Hass has been spending some months in Washington taking advantage of the fine collections and libraries there to add to the value of his course of lectures on archæology. He has been so fortunate as to trace in the uplands of Pennsylvania,

Maryland and Virginia abundant evidence of ancient hill tribes inhabiting these regions burying their dead in rude cists in stone cairns.

FOREIGN.—The department of ethnology now called Demography, represented in England by Francis Galton and in France by M. Bertillon, is becoming more and more popular in its character. A Congress of Demography was held at the Trocadero Palace from July 5–9, and discussed the following topics: Census of Population; Registers of Population; Organization of Statistics; Registration of Births and Deaths, &c. Dr. Daniel Wilson, of Toronto, said at the Buffalo meeting of the American Association that no country in the world afforded a better opportunity of submitting racial problems to the test of figures than our own.

Doctor E. Bessels is publishing, in German, a work on his researches in Greenland. About thirty pages will be devoted to the Greenland Eskimo and will be most beautifully illustrated. By the way, will some one tell us the origin of the word *Keralit*, used by old writers on the Greenland Eskimo? Is it a corruption of the Danish *Skræling?*

Dr. Alexander Ecker has published in Braunschweig a quarto pamphlet of twenty-one pages entitled: Ueber abnorme Behaarung des Menschen insbesondere über die sogenannten Haarmenschen. Gratulationschrift Herrn Carl Theodor von Siebold zur Feier seines 50 jährigen Doctorjubiläums am 22 April, 1878, dargebracht von Alexander Ecker. A few of the illustrations appeared in a late number of *Archiv*, but in its present form the treatise forms one of the most entertaining anthropological articles of the year. The same author has published in Freiburg a quarto pamphlet on Lapland and the Laplanders.

Archivo iper L'Antropologia, 1878. Part I contains the following original papers: Suture anomale dell' osso malare in sei crani umani; Studii intorno ai crani papuani; Selci lavorate dall' uomo in alcuni depositi quaternari del Perugino; Note antropologiche sulla Sardegna; Fisiologia e psicologia; Notizie intorno ai Djelma o Baduvi ed ai Tenger; Su nove crani metopici di razza papua, osservazioni intorno all' influenza del metopismo sui caratteri di razza del cranio.

Professor H. Fischer, of Freiburg, contributes another of his valuable papers on Mineralogical Archæology to Mittheilungen der Anthropologischen Gesellschaft in Wien, 1878. Nos. 1 and 2.

The third part of *Revue d'Anthropologie* for July contains an unusually rich collection of material, but we have space only for the contents: Anatomie Comparée des circonvolutions cérébrales —Le Grand Lobe Limbique et la Scessure Limbique dans la Série des mammifères, by Paul Broca; Essai de Classification des Races Humaines Actuelles, by Paul Topinard. The rest of the *Revue* is taken up with a rèsumé of anthropological matters in various parts of the world. Of M. Broca's eminent services in

the field of cranio-cerebral topography we have frequently spoken. The accompanying table furnishes an idea of M. Topinard's classification:

CLASSIFICATION OF HUMAN RACES.

Hair with circular section (straight),	Dolicho,			Esquimaux.
	Brachy,	Rouge,		Red-skins.
		Olive,		Mexicans. Peruvians.
		Yellow,	America,	Guaranis. Caribs.
			Asia,	Samoyedes. Mongols. Malays (Mongolians).
Hair with intermediate cross section (waved or frizzed),	Dolicho,	Blond,		Cimmerians. Scandinavians. Anglo-Saxons.
		Brown,		Mediterraneans. Semites.
		Black,		Australians. Indo-Abyssinians.
		Red,		Foulbes. Barabras rouges.
	Brachy,	Blond,		Fins.
		Chestnut,		Celts. Slavs.
		Brown,		Iranians.
Hair with elliptical section (wooly),	Dolicho,	Yellowish,		Buschmen.
		Black,	Oceanica, Africa,	Papuas. Caffres. Negritos.
	Brachy,			

GEOGRAPHY AND TRAVELS.[1]

British Association. Sir Wyville Thomson's Address.—At the meeting held at Dublin this year, Sir Wyville Thomson on taking the chair of the Geographical Section began his address with a reference to the return of Mr. Stanley as one of the great events of the year 1877. He expressed admiration of the iron will and daring intrepidity which had successfully carried Mr. Stanley through his African exploration. Although in reading Mr. Stanley's narrative we may be forced to regret some of the dark scenes by which his terrible march was checkered, still no one who has not himself had some dealings with savages can fully understand how entirely the action of a leader, solely responsible for the lives of his party, must be guided in every emergency by considerations which he alone is in a position to weigh. The report, in eighteen volumes (after seventeen years' labor) of the circumnavigating voyage of the Austrian frigate *Novara* was another of the scientific events of the past year. He also referred to the voyage of the Italian corvette *Magenta*, the sounding voyages of Capt. Belknap in the *Tuscarora*, the *Hassler* expedition of the elder Agassiz, the tentative cruises of the British gunboats *Lightning* and *Porcupine*, culminating in the *Challenger* expedition, the expeditions to observe the transit of Venus, the several Swedish expeditions to the Spitzbergen sea, and the Arctic voyage of the *Alert* and *Discovery*, the account of which by Sir George Nares it was impossible to read without a feeling of regret that the devoted little band had attempted what was so

[1] Edited by Ellis H. Yarnall, Philadelphia.

hopeless, and at the same time a conviction that if their task had been practicable by human skill and bravery it must certainly have been accomplished. Speaking of the large contributions of Prof. Mohn and Prof. Sars, of Norway, to our knowledge of the distribution of temperature and the course of ocean currents, he remarked that Prof. Mohn spoke highly of the service rendered by Negretti and Zambra's new reversing thermometer, an instrument so constructed that by a simple mechanical arrangement the temperature might be registered at any given depth irrespective of any number of zones of temperature, higher or lower, through which the instrument may have passed in descending. In the *Challenger* the want of such a thermometer was greatly felt, for in the Arctic and Antarctic seas the coldest layer is frequently on the surface, and a warmer belt intervenes between it and a bottom stratum. At a depth averaging perhaps 500 fathoms we arrive at a temperature of 40° Fahr., and this may be regarded as a kind of neutral band separating the two layers. Above this band the temperature varies over different areas; beneath it the temperature almost universally sinks very slowly and with increasing slowness to a *minimum* at the bottom. Speaking generally, it may be said that the trade winds and their modifications and counter currents are the cause of all movements in the stratum above the neutral layer. One of the most singular results of late investigations is the establishment of the fact that all the vast mass of water, often upwards of 2,000 fathoms in thickness, below the neutral band is moving slowly to the northward, that, in fact, the depths of the Atlantic, the Pacific and the Indian oceans are occupied by tongues of the Antarctic sea, preserving in the main its characteristic temperatures. The immediate explanation of this very unexpected phenomenon seems simple. For some cause as yet not fully understood, evaporation is greatly in excess of precipitation over the northern portion of the land hemisphere, while over the water hemisphere, particularly its southern portion, the reverse is the case. Thus one part of the general circulation of the ocean is carried on through the atmosphere, the water being raised in vapor in the northern hemisphere is hurried by upper wind currents to the zone of low barometric pressure in the south, where it is precipitated in the form of snow or rain. Time would not allow him even to allude to the interesting results obtained from the determination of the density of sea water from different localities and depths. He must, however, say a few words as to certain additions which have been made to our knowledge of the regions round the North and South Poles. The question whether it is possible that there can be at all times or at any time anything in the form of an open Polar sea seems now to be virtually settled, and in the most unsatisfactory manner imaginable. From the observations of Count Wilczek in 1871 and Weyprecht and Payer in the follow-

ing year, and from those of Dr. Hayes in 1861 and Capt. Nares in 1875–6, it is evident that the Polar basin is neither open sea nor continuous ice, but a fatal compromise between the two; and there seems now to be only two plans, one nearly as hopeless as the other, to choose between in any future attempt—either to establish permanent stations, as proposed by Lieut. Weyprecht and already initiated at one point by Capt. Tyson and Capt. Howgate, and to seize the opportunity of running north in early autumn from the station where the sea appears most open, or to run as far north as possible, at enormous expense, with a great force of men, and abundance of provisions, and paraffine oil, and push northwards during the Arctic winter by a chain of communicating stations, with ice-built refuge huts.

But little progress has been made during the past quarter of a century in the actual investigation of the conditions of the Antarctic regions. From information derived from all sources up to the present, it may be gathered that the unpenetrated area of 4,700,000 square miles surrounding the South Pole is by no means a continuous continent, but consists much more probably partly of comparatively low continental land, and partly of a series of continental islands bridged between and combined and covered to a depth of about 1,400 feet by a continuous ice cap. Several considerations appeared to him to be in favor of the view that the area round the South Pole is broken up and not continuous land. We have not only the presumed effect of the transfer of warmer water to the southwards, but in the *Challenger* they had been able to detect its presence by the thermometer in high southern latitudes. It seems that all the icebergs are originally tabular, the surface being perfectly level and parallel with the surface of the sea, a cliff of about 230 feet high bounding the berg. It seems probable that under the enormous pressure to which the ice is subjected a constant system of melting is going on, the water passing down by gravitation from layer to layer until it reaches the floor of the ice sheet, and finally working out channels for itself between the ice and land. He could scarcely regret that it was utterly impossible for him on this occasion to enter into details with regard to the relations of the abyssal fauna. He must admit that the relations of the abyssal fauna to the fauna of the older tertiary and newer mesozoic periods, though much closer than those of the fauna of shallow water, were not so close as he had expected them to be; but he felt that until the zoölogical results of several later voyages, and especially those of the *Challenger*, should have been fully worked out, it would be premature to commit himself to any generalizations. Within the last decade the advance of knowledge bearing upon the physical geography of the sea has been confusingly rapid, so much so that at this moment accumulation of new material has far outstripped the power of combining, and digesting, and methodizing it. Steady progress is, however,

being made, and he trusted that in a few years our ideas as to the condition of the depths of the sea may be as definite as they are with regard to regions to which we have long had ready access. —London *Times.*

THE ARABIAN DESERT OF EGYPT.—Dr. G. Schweinfurth writes from Cairo, on the 18th of June, to the London *Athenæum* an account of his visit to the desert region lying between the Nile and the Red Sea. He started from a village near Atfih, on the Nile, on March 29th, and, taking a circuitous route, in the course of which he examined, more or less minutely, fifty-five wadis, returned to the Nile opposite to the town of Siut, on June 9th. Whilst he found remains of Roman settlements, neither inscriptions nor ruins indicate any knowledge of this region by the ancient Egyptians. The orographical and hydrographical features of this territory, to the east of the Nile, are far more varied than might have been expected. Every wadi has its own physiognomy. The rocks may belong to the same geological formation, but they vary exceedingly in contour and configuration. The wadis wind about in a curious manner, sloping down gently or steeply; the vegetation met within them is sometimes sporadic, at others ephemeral or continual; the animal world, too, contributes to impress a character upon each of the two hundred principal wadis which are met with in this small corner of Northeastern Africa.

MICROSCOPY.[1]

NATIONAL MICROSCOPICAL CONGRESS—This Convention, a call for which had been published by the Indianapolis Lyceum of Nat. Hist., assembled at Indianapolis on Wednesday morning, August 14th. About sixty members were in attendance, representing fifteen microscopical societies in different parts of the country. Rev. A. B. Hervey was appointed chairman, and H. F. Atwood, secretary. Addresses of welcome were made by Mayor Caven and Dr. O. Evarts, and responded to by the chairman. Regular organization was then effected by the election of the following officers: President, Dr. R. H. Ward, of Troy; vice-presidents, Prof. J. E. Smith, of Cleveland, and Dr. W. W. Butterfield, of Indianapolis; secretary, H. F. Atwood, of Chicago; treasurer, Dr. J. B. Marvin, of Louisville. Four days were occupied with the meetings except Friday afternoon, which was devoted to a railway excursion. On Friday evening a soirée was given at the court house, which was largely attended by citizens. Owing to the large attendance and the limited number of instruments, no effort was made to classify the objects, and the exhibition was of altogether a popular character. On the last day of the meetings a special committee, which had been previously appointed, reported in favor of organizing permanently under the name of the "American Society of Microscopists," with a membership

[1] This department is edited by DR. R. H. WARD, Troy, N. Y.

open to all persons interested in microscopical science, and with meetings to be held annually at places selected during the previous meeting. After much discussion and no little difference of opinion as to radical points, the plan was adopted as reported, and Buffalo fixed upon as the place of meeting for next August. The following officers were unanimously elected for the first year: President, Dr. R. H. Ward, of Troy; vice-Presidents, S. W. Dennis, of San Francisco, and C. M. Vorce, of Cleveland; secretary, Dr. H. Jameson, of Indianapolis; treasurer, H. F. Atwood, of Chicago. The president-elect insisted upon declining election on the ground of having been presiding officer of the Congress, but finally withdrew his resignation. During the meeting papers were read on the following subjects, interesting discussions being drawn out by many of the papers:

"Limit of accuracy attainable in measurements with the microscope," by Prof. Wm. A. Rogers, of Cambridge. "Some new forms of mounting," by C. C. Merriman, of Rochester. Abstracts of these two papers will be published in a succeeding number.

"Formulæ of objectives," by W. H. Bulloch, of Chicago. The construction of several modern lenses of large immersion aperture was given in diagrams constructed from the lenses themselves, with results remarkably close to those formerly obtained by tracing the light mathematically through the objectives according to the data furnished by the makers.

"Angular aperture," by Dr. G. E. Blackham, of Dunkirk, N. Y. This paper gave a full review of the literature of the subject, limited angular aperture to the angular distance of the outside rays of the widest pencil of light, which the object glass could gather up and bring to a focus, with the formation of a well defined image of the object, and insisted upon the superiority, for all purposes, of well constructed objectives of extremely wide angle.

"Angular aperture defined," by Prof. Romyn Hitchcock, of New York. In order that the term angular aperture should mean something definite, and to avoid ambiguity and misunderstanding in future discussion on the subject, it was proposed to adopt a definition of the term which, right or wrong, should be recommended to the microscopists of the country as a convenient and uniform usage. The triangle method was proposed for general adoption, considering the angular aperture of a microscope objective to be the angle of the apex of a triangle having a base equal to the available diameter of the front lens, and a height equal to the actual focal length (working distance), measured in air for a dry lens, and in the fluid employed for an immersion, the collar being adjusted for the most perfect definition in every case. While nearly all the members seemed to be personally in favor of the usage proposed, a motion that the congress should attempt to settle the question by requesting its general adoption met with so much opposition that it was withdrawn.

"Mechanical fingers," by C. M. Vorce, of Cleveland. In this paper the mechanical finger was spoken of as a kind of stage forceps adapted to objects too small and fragile for ordinary forceps, and as an important accessory for the microscope, even as a means of study of minute forms and to those who do not wish to mount objects. Those forms of finger were described which are attached to the objective or to the movable stage, and the home manufacture of them recommended as easy and effective. Their efficiency is greater in proportion to the greater number of movements of the stage and sub-stage. The apparatus should be furnished with a variety of points for different kinds of work, varying from a fine mouse-whisker to a split point of whalebone or quill.

"Microscopical study of the ashes of leaves," by Dr. R. H. Ward, of Troy, describes the method by which leaf ashes may be prepared so as to preserve much of the structure of the leaf. The books speak of the siliceous residue of the leaves of the grasses, but many other leaves are equally available. Leaves of trees are generally used with more success than those of herbs, and they should be gathered late in the summer. A piece of dry leaf is laid on a strip of platinum foil or thin mica, covered with mica or a cover-glass to prevent curling up, and carefully heated over an alcohol lamp or Bunsen burner until the organic matter is slowly burned out and the mineral matter, or ash, remains undisturbed. This is then dropped on to a slide, wet with turpentine, and very carefully mounted in soft balsam. If slightly crushed in mounting, or containing a trace of carbon at some point, the value of the object is often increased. These preparations can be made with great ease and rapidity, and show the construction of the parenchyma, veins, epidermis, stomates and hairs with great beauty and distinctness. In this way was prepared a slide of leaf ashes which was recently sent through the circuits of the Postal Club and which excited an unexpected amount of interest and correspondence.

"Classification of algæ," by Rev. A. B. Hervey, described the systematic arrangement of sea weeds by means of their peculiarities of reproduction, and showed how completely our knowledge of the subject is due to the microscope. The writer urged the more frequent preparation, for use and for exchange, of series of slides illustrating typical species in groups studied by specialists in natural history.—(*To be Continued.*)

MICROSCOPICAL DIRECTORY.—The fullest list of American microscopists yet published will be found in the "Naturalists' Directory for 1878," published by S. E. Cassino, Salem, Mass.

EXCHANGES.—Lake Michigan diatoms mounted or raw material, also diatoms of Northern Illinois, for good slides or material. B. W. Thomas, 132 La Salle street, Chicago, Ill.

SCIENTIFIC NEWS.

— We have received a specimen of the first number of the *Zoologischer Anzeiger*, edited by Prof. J. V. Carus. From twenty-five to twenty-six sheets, of sixteen pages each, will appear each year, a sheet about once a fortnight, we suppose. The literature in all departments except descriptive zoölogy is fully given by title; digests or abstracts of important works are given, C. O. Whitman's embryology of Clepsine being thus noticed. The *Anzeiger* will also contain short notices, zoölogical, zoötomical, faunistic, phænological and biological, with laboratory notes as to improved methods of working, information regarding museums, private collections and personal notices. The plan of this zoölogical index is excellent, and will undoubtedly prove a most convenient medium for advanced zoölogists.

— Arrivals at the Philadelphia Zoölogical Garden: 1 gray squirrel (*Sciurus carolinensis*); 3 beavers (*Castor fiber*), born in the garden; 1 diamond rattlesnake (*Crotalus adamanteus*); 1 ground rattlesnake (*Candisona miliaria*); 1 whip snake (*Bascanion flagelliforme*); 1 black snake (*Bascanion constrictor*); 1 spreading adder (*Heterodon platyrhinos*); 2 brown-throated parrakeets (*Conurus æruginosus*); 1 snake (*Coluber obsoletus, confinis*); 3 bald eagles (*Haliætus leucocephalus*); 1 king snake (*Ophibolus getulus*); 1 woodchuck (*Arctomys monax*); 1 robin (*Turdus migratorius*); 1 snake (*Coluber vulpinus*); 1 rufous rat kangaroo (*Hypsiprymnus rufuscens*), born in the garden; 11 lizards (*Sceloporus undulatus*); 1 red fox (*Vulpes fulvus*).—*Arthur E. Brown, Supt. of Garden, Sept.* 1, 1878.

— The Commissioner of Agriculture has appointed Mr. A. R. Grote, of Buffalo, N. Y., Wm. J. Jones, of Virginia Point, near Galveston, Texas, E. H. Anderson, of Kirkwood, Miss., and Prof. Comstock, of Cornell University, observers, under the control of the entomologist of the Department, to make investigations and study the action of the cotton worm during the present season.

— Prof. Carl Stål, Director of the Department of Entomology of the Royal Museum at Stockholm, died June 13, 1878, aged forty-five years. He was a voluminous author, publishing monographs of different groups of Coleoptera, Hemiptera and Orthoptera.

— Dr. John H. Packard reports in the Medical and Surgical Reporter (Phil., Aug. 3, p. 100) that a child six years of age blew from its nostrils a specimen of Geophilus, a long, slender, small, centipede-like myriopod.

— Herr A. Reipert, of Bensheim, Burgstrasse, Grossl. Hessen, is desirous of corresponding with American entomologists with a view to exchanging European for American insects.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The American Association for the Advancement of Science met at St. Louis, August 21st, the session lasting a week. The president was Prof. O. C. Marsh, Prof. Simon Newcomb being the retiring president. Reports of the eclipse observers seemed to have overshadowed the papers read in the section of geology and biology. The attendance and number of papers read was smaller than the preceding year. An excursion to Colorado took place at the close of the meeting.

The British Association met at Dublin, August 14th, under the presidency of Dr. Spottiswoode, the number of members present being 2,577. The addresses of Mr. Evans on Geology, of Prof. Flower on Vertebrate Zoölogy, and of Mr. Romanes on Animal Intelligence were of especial interest, as well as the address of Sir Wyville Thompson on Recent Progress in Ocean Geography.

The Meeting of German Naturalists and Physicians was held at Cassel, September 11–18, the president being Dr. B. Stilling.

The French Association for the Advancement of Science was presided over by M. E. Fremy. Prof. Marey delivered a lecture on Graphic Researches relative to Animal Motors, and papers were read by M. Alix on the Myology of Mammals, by Prof. A. Gaudry on the Evolution of Primitive Mammals, and M. A. F. Nogues on Method in Geology and on the Climatology of Geological Times.

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SCIENTIFIC SERIALS.[1]

The American Journal of Science.—September. On the animal of *Millepora alcicornis*, by W. N. Rice. Forest geography and archæology, by A. Gray (continued from p. 94). Notice of some recent additions to the marine fauna of the eastern coast of North America, by A. E. Verrill. The Waverly Group in Central Ohio, by L. E. Hicks. On some primordial fossils from South-eastern Newfoundland, by J. F. Whiteaves. New pterodactyle from the Jurassic of the Rocky mountains, by O. C. Marsh.

Siebold and Kölliker's Zeitschrift für wissenschaftliche Zoologie.—July 30, 1878. On the Siphonophores of deep water, by Th. Studer. Morphology of the Oxytrichinæ, by V. Sterki. Trichaster elegans, by H. Ludwig. Contributions to a knowledge of the Tomopteridæ, by F. Vejdoosky. Contributions to a knowledge of the natural history of the Caprellæ, by A. Gamroth.

Quarterly Journal of Conchology.—August. List of shells of Iowa, by F. M. Witter.

[1] The articles mentioned under this head are usually selected.